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A MODERN MAILED KNIGHT OF THE DEEP.—[See page 133.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

To Manage the Manager

THE Rapid Transit Subway in this city was built to carry, according to the most sanguine estimates of the engineers, a maximum daily traffic of 400,000 passengers. At the present time it is carrying an average of 800,000 per day. This is a feat of transportation (without a parallel in this or any other city) which reflects the greatest credit upon the operating staff of the Interborough Company. Particularly meritorious is the operation of the subway in the rush hours. Everything that modern engineering can do to safely handle the vast crowds during these periods has been done.

And yet it is a fact that the Interborough Company is greatly disliked by the traveling public; and the reason is not far to seek. There is no doubt that the chief reason for this unpopularity is the company's disobedience to the reasonable orders of the Public Service Commission for better car accommodation *between* the rush hours.

The public has been particularly exasperated by the running of short trains at long intervals, after theater hours, passengers having frequently to wait a long time in cold, draughty stations, on crowded platforms, only to find the train, consisting of two or three cars, already so packed with straphangers that no more can get on without peril. Often, after another long wait, a second short train may be found to be equally crowded, and a third may arrive before any seats are available. Such operation of the subway has naturally irritated the public and has provoked the bitter opposition to the company.

When it is considered that all this has been done in arrogant disobedience of entirely reasonable orders issued, after public and patient hearings, by the Public Service Commission, it is no wonder that such an attitude has left a lasting impression, and has engendered a decided spirit of antagonism to any further business dealings with that company.

The legal means which the Public Service Commission may employ for compelling obedience to its orders are inadequate and very clumsy. It has to proceed against the offending company by regular suits in the courts; where, after interminable arguments and delay, a fine may be imposed upon the corporation, which, as a rule, is only a fraction of the additional money which the company has made out of the public by its persistent disregard of public convenience. The Interborough Company will have only itself to blame if the city seek relief through some form of drastic legislation.

We believe, however, that a resort to the Legislature is unnecessary, and that the relation of the Interborough Company to the public can be more efficiently regulated by the insertion of certain provisions in the agreement which will probably be made between the Interborough Company and the city for the extension of its lines and their operation.

One provision which we would particularly urge the city and public authorities to insert in the new contract is one to the effect that any employee of the Interborough Company, or of any company related to it for construction or operation, shall be immediately dismissed from service upon the order of the Public Service Commission, if, in the judgment of this Commission, the conduct of such employee shall be prejudicial to the public interest.

A provision of this kind would have the force of law, and would be the most effective means for the Public Service Commission to control the offending corporation. A precedent for such a rule is to be found in every important contract for large work between railroad companies and contractors. It is contained, in most explicit terms, in the printed forms for large contracts for city work. It will be included in the contract for the construction of the additions to the subway. By extending its scope to include operation as well as construction (the new contract will cover both), the city will insure that the subway shall be both built and run in the way it wishes.

Past experience in large city and railroad contracts make it certain that the Public Service Commission will but rarely be called upon to exercise its power of dismissal; whose mere existence will act as a strong deterrent upon employees against misbehavior. After the Commission has been called upon to summarily dismiss a few offenders, the public would certainly be spared the spectacle of a General Manager of a corporation defying and sneering at the reasonable orders issued for the safety and convenience of the passengers. Every employee, from the general manager down to the conductor and special guard, would know that his conduct would be subject to an immediate accounting to the controlling public authority. This would have the most salutary effect upon the management from top to bottom. An order from the Public Service Commission would then really be an order, instead of what it is now, merely a challenge to a legal duel in the courts.

Now that a new agreement with the Interborough Company is proposed to be made, the city should seize the opportunity to strengthen the hands of the Public Service Commission. The remedy would prove to be swift and sure. By its adoption the public would be relieved from the present exasperating conditions and the Public Service Commission would be raised to a position of dignified authority.

The Communipaw Dynamite Disaster

THE explosion at Communipaw, Jersey City, of a large amount of dynamite, variously estimated at from 10 to 25 tons, must be reckoned as one of the most serious disasters of the kind on record in the United States. Two carloads of dynamite stood on the pier, and the contents of one of these was being unloaded by sliding the cases down an inclined chute to the hold of a steamer. As the whistles sounded for the noon hour, there was an explosion of the dynamite in the hold of the vessel. Twenty-five or thirty workmen were killed, the steamer was blown out of existence, and the air wave, set up by the liberation of enormous volumes of gas, wrecked the lighter structures in the vicinity, and produced the usual phenomena of broken glass and violent shock, the effects of the latter being felt for a distance of forty miles. In accidents of this character, any attempt to get at the causes must necessarily take the form of mere guesswork, and this for the reason that the only people who could give any evidence as close eyewitnesses are invariably killed. It was so in the present case.

The disaster has been followed by the usual outburst of activity on the part of federal, state, and municipal authorities, and it would seem as though every person that might be even remotely related to the explosion has been arrested. Drastic legislation is promised, and so forth, and so on—all of which seems to savor of the policy of latching the barn door after the horse has escaped.

Although the investigation of the disaster should be as thorough as the law can make it, the authorities should avoid panic measures and be careful not to lose sight of the salient facts. In the first place, dynamite, in spite of its enormous destructive energy, can be and is made so safe by modern methods of manufacture, that it can be handled, shipped, unloaded and loaded with a large degree of security always provided, of course, that the civil laws which govern its shipment, and the physical laws which govern its safe handling, are observed. But while commercial dynamite for blasting purposes is now manufactured in such a way as to be exceedingly difficult to explode, except by special appliances, it is still subject to that fruitful cause of accident, the uncertainties of the human element. Familiarity breeds contempt, even in the handling of high explosives; and were it not for inexcusable, sometimes positively willful, carelessness, the number of disasters and fatalities would be reduced, we believe, almost to the vanishing point.

Nitro-glycerine in the pure state is a material of enormous explosive energy and great sensitiveness. To Nobel we owe the important discovery that, when it is absorbed in infusorial earth, it loses its sensitiveness and may be handled freely. Gelatine dynamite, of the kind that caused the Jersey City disaster, is prepared by dissolving nitrocellulose in the nitro-glycerine for the purpose of gelatinizing or thickening it, and then adding woodmeal, powdered nitrate of sodium, and other ingredients, until a thick, heavy, tenacious paste is formed, which is remarkably insensitive to the shocks received during its commercial use. There is a case on record of a train wreck in which the end of a car containing forcite, a form of gelatine dynamite, was smashed; the cases of dynamite broken open, and the sticks of the explosive strewn over the tracks, some of them being crushed by the wheels passing over them, all of which rough usage failed to produce an explosion. Perhaps the most remarkable test to which it could have been put occurred in this very explosion at Jersey City, when the contents of the second loaded car, which was lying opposite the ill-fated steamer, passed through the terrific ordeal without exploding.

If, then, one carload of this consignment of dynamite was so extraordinarily insensitive to rough usage, how came the other carload, which was being loaded into the steamer, to blow up as it did? The explosion may have been due to the fall of a case, the contents of which may have suffered chemical deterioration; though this possibility is remote, the stability of the present commercial dynamite being one of its marked characteristics. It is possible, also, that, the steamer being regularly employed in carrying high explosives, there may have been in the hold a small quantity of nitro-glycerine or some black powder which needed only a minor shock or the ashes from a workman's pipe to start the mischief. Detonating caps of fulminate of mercury may have formed part of the cargo, and the accidental detonation of these would have been sufficient to explode the dynamite.

A member of our staff, who witnessed the explosion from the New York side, speaks of hearing the two distinct explosions, the first rather mild, followed by a second and greater shock. It is possible that the boilers exploded; in which event, the flying metal and hot coals would prove sufficient predisposing causes.

Our governing bodies, whether federal, state, or municipal, should move cautiously in enacting additional legislation to safeguard the shipment and storage of dynamite. Dynamite enters so largely into modern engineering and constructive work, that any measures which would tend to increase its cost or check the freedom with which it can be carried to its destination and stored and handled on the work would have a serious effect upon the great constructive works in the fields of engineering.

As a matter of fact, what is needed is not so much stricter laws as greater care in the enforcement and observance of those we already have. Such facts as have come to light regarding the Jersey City explosion seem to indicate that, in more quarters than one, there was gross lack of supervision and deliberate violation of the existing laws governing the transportation of high explosives.

How Leaves Keep Clean

THE shape of leaves is one of the first things a student of botany learns to distinguish. Even the most careless observer sees that some trees and plants have leaves with smooth, rounded edges, while others have their leaves furnished with long points or divided into narrow lobes terminating in drooping or curved ends. While these leaf shapes have formed a subject of study ever since botanical science has existed, it is only within recent years that one of the most remarkable purposes which the points of leaves serve has been clearly brought out. It was shown, as the result of some special investigations made in Germany, that the long points quickly drain off the excess of moisture deposited upon the foliage in heavy rains. This ready method of disposing of a surplus of moisture is important to some plants. It also serves as a means of cleansing the surface of the leaves. Round leaves do not so easily get rid of the rain-water, and it has been noticed that they remain dusty and dirty after a shower, the escape of the water by evaporation not tending to cleanse them, while long, narrow and pointed leaves are washed clean and bright.

John Ambrose Fleming, F.R.S.

The Noted Electrician and Wireless Telegraphy Expert

By P. F. Mottelay

JOHN AMBROSE FLEMING was born at Lancaster, November 29th, 1849, the son of the Rev. James Fleming, D.D., and received his first schooling at the University College School, London, which he entered at an early age during the headmastership of Prof. T. H. Key. He afterward attended University College in preparation for the engineering profession, and, after two years spent under such masters as Profs. Hirst, De Morgan, and Williamson, while following up courses of private study, he graduated in 1870 as Bachelor of Science. He then entered the Normal School of Science in South Kensington, where he studied under Prof. Guthrie and others. During 1873 and 1874 he acted as demonstrator in the laboratories of the Royal College of Chemistry, and also as private assistant to the late Sir Edward Frankland (1825-1899), whose name has been so prominently associated with that of Sir Norman Lockyer in spectroscopic and other researches. At this period Prof. Guthrie was engaged in founding the Physical Society of London, and the first man to present a paper before the new society was Fleming, who spoke on the "New Contact Theory of the Galvanic Cell." During 1874 Prof. Fleming was appointed Science Master and special lecturer on physics and chemistry in the Military Department of Cheltenham College, but resigned early in 1877 to go to Cambridge. There, working in conjunction with Clerk Maxwell in the Cavendish Laboratory, he made an elaborate investigation of and report upon the British Association Standards of Resistance, mainly to determine their variation with temperature.

In recognition of his great merits he was elected successively Exhibitor in Natural Science (1877), Foundation Scholar of his college (1879), Hare Exhibitioner, Wright's Prizeman, and Hughes Prizeman, the last being a special award annually conferred on the Foundation Scholar who has most distinguished himself in mathematics and in natural philosophy.

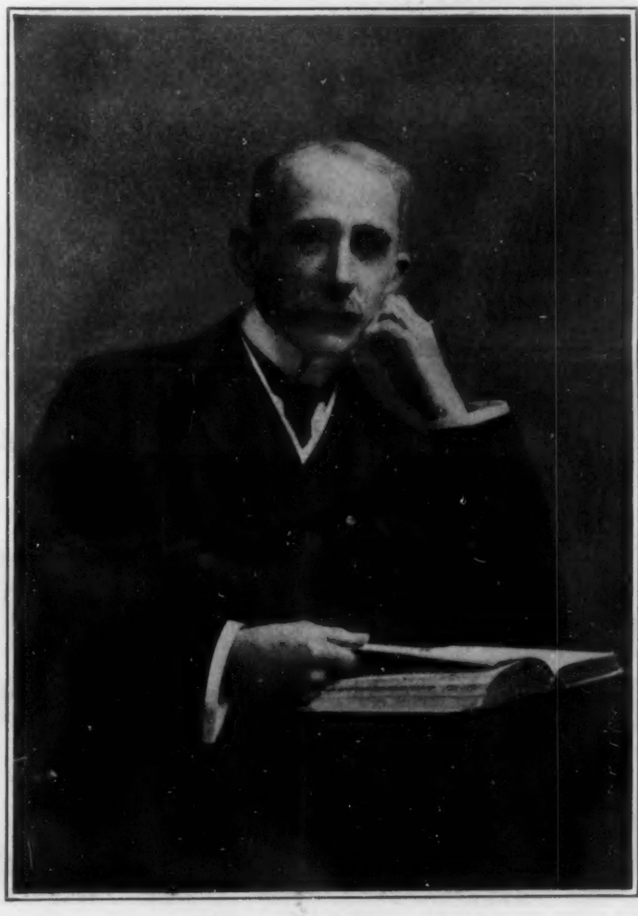
At the end of his third Cambridge year (1879) he took the degree of Doctor of Science in the University of London and that of Bachelor of Arts at Cambridge with special distinction in the Natural Science Tripos. In 1880 he was appointed University Demonstrator in mechanics and in applied science under Prof. James Stuart, whom he assisted in the designing and construction of the Cambridge Engineering Laboratories, while at the same time lecturing in the mechanical engineering workshops. When University College, Nottingham, was opened in the year following (1881) Dr. Fleming was selected out of a large number of candidates as the first occupant of the newly-founded chair of mathematics and physics of that institution. It was in this same year (1881) that electric lighting began to attract public attention. The new field proved so attractive and promising to Dr. Fleming that, after a short residence in Nottingham, he resigned his professorship in order to remove to London, where, upon the organization of the Edison Electric Light Company (1882), he was appointed their electrical engineer. On the amalgamation of the Edison and of the Swan companies during 1883, he continued as advising electrician to the new concern, and in that capacity was naturally connected very prominently with the first introduction of incandescent electric lighting throughout Great Britain.

In 1885 he became the first occupant of the newly-created chair of electrical engineering at University College, London, while still retaining the chair of mechanical engineering which had been founded there several years before, and he succeeded, not very long after, in obtaining sufficient aid to insure the much-needed additional accommodations for practical engineering instruction. These were founded by the erection at University College of what now proves to be one of the most complete engineering and electrical laboratories. Its total cost amounted to nearly £15,000. The inauguration of the new buildings took place in 1893.

When the friends of the late Sir John Pender, the great Scottish pioneer of submarine telegraphy (1815-1896), concluded to erect a memorial to him, it was decided that the most suitable way of expressing their appreciation would be to found a chair of electrical engineering at University College, London, and a sum of £5,000, part of the amount collected by public subscription, was accordingly presented in advance to the college as early as July 2nd, 1897, at a public meeting which was presided over by the Marquis of Tweedale. When the whole fund was handed over, it was with the condition that it be used to maintain an electrical laboratory to be known as the Pender Laboratory, and that Dr. Fleming occupy the newly-created Pender Chair of Electrical Engineering. This he still occupies at the present day.

His interest in popular education, always very great, resulted in the establishment of the Morley Memorial College, Waterloo Bridge Road, London. Since 1899 Dr. Fleming has been scientific adviser of the Marconi Wireless Telegraph Company, and of late he has held the post of department editor of electricity in connection with the eleventh edition of the Encyclopædia Britannica.

Among his most important scientific papers may be mentioned the one read, during 1885, before the Institution of Electrical Engineers urging the necessity of a standardizing laboratory for testing electrical instruments, which led to the establishment at Richmond Terrace of the Board of Trade Electrical Laboratory, and later on to the National Physical Laboratory.



PROF. J. A. FLEMING, F.R.S.

He has delivered numerous courses of lectures before the Society of Arts and the Royal Institution. His Cantor Lectures at the Society of Arts were "On Alternating Current Measurements," "Alternate Current Transformers," "Electric Oscillations and Electric Waves," and "Hertzian Wave Telegraph." They were all translated into German and into Japanese, and were republished in the United States. Before the Royal Institution he has delivered both afternoon and evening lectures. Some of those given on Friday evenings were entitled "The Physics of an Electric Lamp," "Electro-magnetic Repulsion," "Electric and Magnetic Research at Low Temperatures," "The Electronic Theory of Electricity," and "Recent Progress in Electric Wave Telegraphy." Those of the afternoon were on "The Induction Coil," "Electric Illumination," "Magnetic Properties of Iron," and "Wireless Telegraphy," in addition to two special courses of Christmas lectures during 1894-1895, respectively, on "The Work of an Electric Current" and "On Waves and Ripples in Water, Air, and Ether."

In conjunction with Sir James Dewar he is the author of communications to be found in the *Philosophical Magazine*, 1882, 1883, 1895 (two papers), and in Proceedings Royal Society, 1896 (six papers), 1897 (six papers), 1898, the last being "On the Magnetic Susceptibility of Liquid Oxygen." He is likewise the author of papers on "Problems of Electric Flow in Networks of Conductors," "Molecular Shadows in Incandescent Lamps," and "The Use of the Daniell Cell as a Standard of Electromotive Force." For the paper on "Electromagnetic Repulsion" he was awarded the silver medal of the Society of Arts.

At the anniversary meeting of the Royal Society, held in London, as usual, on St. Andrew's Day, November 30th, 1910, its president, Sir Archibald Geikie, K. C. B., presented to Dr. Fleming the Hughes gold medal, accompanying it with the following remarks: "For thirty years he has been actively engaged in researches in experimental physics, chiefly in the technical applications of electricity. He was an early investigator of the properties of the glow lamp, and elucidated the unilateral conductivity presented in its partial vacuum between glowing carbon and adjacent metal, a phenomenon which has been looked upon recently as connected with the important subject of the specific discharges of electrons by different materials. He has published in the scientific and technical press and in technical text-books many admirable experimental investigations and valuable expositions in the application of electricity, as, for example, to electric transformers and wireless telegraphy. Of special interest and value for them were the important results concerning the alterations in the physical properties of matter, such as the remarkable increase in the electric conductivity of metals when subjected to very low temperatures, which flowed from his early collaboration with Sir James Dewar in investigating this domain. In recent years he has taken a prominent part in the scientific development of telegraphy by free electric waves."

He is the author of a large number of books, of which we shall mention only two: "Principles of Electric Wave Telegraphy" (1906); "Elementary Manual of Radio-Telegraphy and Radio-Telephony" (1908). The work published by Longmans in 1906 contains three appendixes, which give the original wireless telegraphy act of 1904, the entire bibliography (books as well as original papers and lectures), and lists of British patents relating to the subject granted in 1896-1905.

Dr. Fleming was elected a Fellow of St. John's College, Cambridge, in 1883; a Fellow of University College, London, in 1884, and a Fellow of the English Royal Society in 1892. He is also a member of the Royal Institution of Great Britain, and has been vice-president of both the Institution of Electrical Engineers and the Physical Society of London.

A New Farm Crop

WILLIAM H. HOLMES, Chief of the Bureau of American Ethnology at Washington, D. C., is not only eminent as an ethnologist, but is recognized as a painter of very good pictures. He recently acquired a small farm in one of the picturesque sections of Maryland adjoining the District, and shortly after the purchase was advised by Mr. P——, a well-known financier and prosperous farmer of the neighbor hood, not to let anybody lead him into spending large sums in improving his farm, but to be economical about it. Following his artistic instincts, it pleased Mr. Holmes to let the farm grow largely in weeds, and meeting Mr. P—— after a year's residence on the farm, Mr. Holmes said, "Well, Mr. P——, I took your advice about that farm. I paid $1,800 for the farm, haven't spent a cent on it in improvements, and in the last year I have sold $900 worth of sketches off that farm;" adding, "I don't believe, Mr. P——, you could beat that yourself."

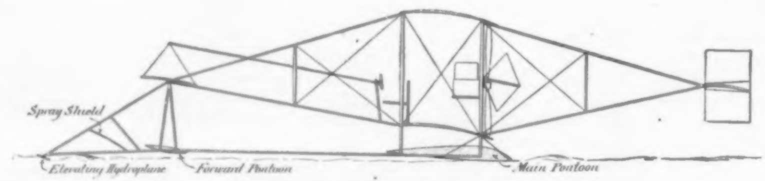
First Flight of an American Aeroplane from the Water

How an Important Problem in the Naval Aeroplane was Solved

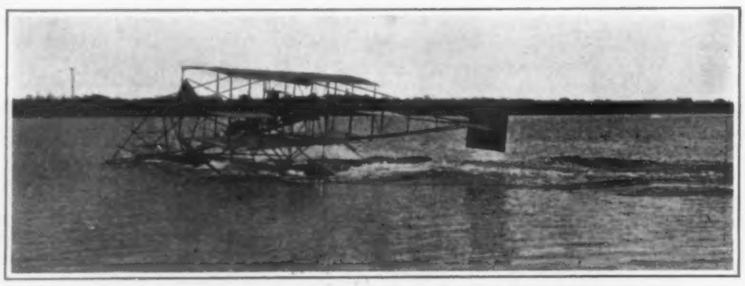
By John Fulton Greer

A POTENTIAL fact as regards the efficiency of the aeroplane in its connection with naval warfare was established Thursday, January 26th, when Glenn H. Curtiss in his experimental hydro-aeroplane flew from the surface of the bay of San Diego, California, and after circling about the tops of the masts in the harbor, alighted on the water with the ease and assurance of a great sea bird. As in many other experiments of man in his world-old battle to conquer the forces of nature, there was the element of accident when success finally crowned the efforts of America's most scientific aviator. A small group of interested friends had gathered on the shores of the bay to witness a trial spin on the surface of the water, in which Curtiss proposed to test his hydroplane pontoons. The machine was pushed into the water from the hangar erected upon the beach in front of Curtiss' recently established army and navy aviation school. The engine was started and at the word to let go the machine glided swiftly out toward deep water. As it gained speed the pontoons lifted until it was apparent to the aviator that his main water support was nearly out of water. As the head resistance and skin friction were reduced, the speed increased, and suddenly Curtiss realized he was getting dangerously near the shore. "There was nothing else to do," he said afterward, "so I tilted the elevating plane, and to my surprise the machine rose from the surface of the water as easily as I had ever left the ground." At the required altitude Curtiss turned the machine toward deep water again, this time in the air, and after a few seconds aloft, alighted as gracefully as he had ascended.

Not satisfied with the first flight, Curtiss at once had his assistants start the propeller; and, after a short run on the surface, he again ascended, circled over the channel, and alighted after one minute and twenty-one seconds in the air. He announced to his friends that he was satisfied that the experimental stage of flying from and alighting on the surface of the water was at an end so far as he was concerned. Twice again during the day he made experimental flights, and the following day he went up and remained aloft three and one-half minutes, stating when he returned to the beach, that he could have remained in the air until his supply of fuel was exhausted. The aeroplane balanced as perfectly with the pontoons beneath the wings as it ever did on wheels, and the 8-cylinder, 50-horse-power Curtiss engine did its work without a miss.



Position of pontoons at the instant of rising from the water.



Snapshot of Curtiss gathering headway before flight.

Entering the water for the first trial.

Rear view, showing the main pontoon.

THE FIRST AMERICAN FLIGHT FROM THE WATER

The pontoons or hollow hydroplanes developed by Curtiss are of peculiar construction, altogether different from many newspaper illustrations of his remarkable flights at San Diego. In reality, after a speed of thirty miles an hour is reached, the main pontoon sustains the machine. This apparatus is constructed of steel sheets laid over a wooden framework. A horizontal cross section, midway between top and bottom, would show a perfect parallelogram six feet from side to side and seven feet from front to rear. At the rear is a "tail," eight inches deep, extending the full width of the pontoon. The greatest depth of the pontoon (at the center) is sixteen inches between surfaces. As attached to the frame of the aeroplane, it is inclined slightly upward, so that when full speed is attained just before leaving the water, practically, the only part submerged is the extreme rear of the pontoon and the "tail."

This pontoon takes the place of the two rear wheels on the Curtiss type of aeroplane, and it acts with a hydroplane effect, rising to the surface of the water as the speed increases.

In front of the main pontoon, at the point where the single wheel is attached on the ordinary land machine, is fixed a small pontoon or "shoe" of approximately the same shape, eighteen inches wide, forty inches long, and six inches deep. This pontoon answers the same purpose on water that the forward wheel does on land. Above the front pontoon and a little forward is a canvass covered watershield six feet wide and two feet high, tilted at an angle of forty five degrees. This apparatus is to protect the aviator and machinery from the upward swish of the water; also to add to the buoyancy of the machine in case of a sudden tendency to dive.

At the extreme forward end of the framework, and at about one foot lower level than the front of the small pontoon, is attached a wooden hydroplane, six feet long, eight inches high and one and one-half inches thick. This is tilted at an angle of about twenty-five degrees and is intended to aid in lifting the forward part of the machine when it is under way.

The forward elevating plane, ailerons, main planes and rear control are the same as the ordinary type of Curtiss racing biplane, the main planes having a spread of twenty-six feet and a width of four feet and nine inches. The speed in the air is from 50 to 55 miles an hour.

McCurdy's Flight Across the Florida Straits

MR. J. A. D. McCURDY, the well-known Canadian aviator, attempted the flight from Key West to Havana, Cuba, in his Curtiss biplane, on January 31st.

The start was made at 8:30 A. M. against a light breeze. Four torpedo-boat destroyers—the "Paulding," "Terry," "Drayton," and "Roe"—were stationed at intervals of ten miles, the "Paulding" being thirty-five miles from Havana.

At 8:34 McCurdy started. Half an hour later he was sighted by the officers on the "Roe," and in ten minutes he passed over the destroyer at a height of five hundred feet. All the torpedo boats emitted black smoke in order to guide the aviator. He passed two of the three remaining boats in good style, and they were in hot pursuit, while the "Paulding" was still ahead, steaming under forced draft. Suddenly, after he had been flying for about two hours and was within ten miles of Cuba, McCurdy seemed to settle down and light upon the water. A crack had developed in the crank case of his motor, and the lubricating oil had escaped. He decided to descend, although his goal was in view. His machine alighted easily, and was floated readily by the two cylindrical floats beneath the lower main plane. McCurdy was taken from the aeroplane in a boat. An inclined platform had been constructed on the "Paulding" for the purpose of drawing the aeroplane on board, but this was broken, and the machine had to be hauled aboard.

McCurdy's account of the wonderful view spread out before him as he started on his flight was graphic in the extreme. From a height of 1,000 feet the sea seemed a huge panorama upon which the funnels of the destroyers showed as black spots in the distance. The appearance of the ocean as though painted on a vertical canvas was apparently due to a mirage effect caused by the recently risen sun and by McCurdy's elevation. It seemed but a short time to him before Morro Castle and Havana harbor came into view. The distance of some ninety-six miles covered in less than two hours was traversed at about forty-eight miles an hour. McCurdy won $8,000 by making this flight from Key West, the two prizes of $5,000 and $3,000 being awarded to him despite the fact that he was unable to cover the entire distance owing to the accident. The best previous record of a flight over water was that of Glenn H. Curtiss from Albany to New York above the Hudson River on May 29th of last year. He covered 150 miles with two stops. Later in the year Curtiss flew 63¾ miles above Lake Erie, going from Cleveland to Cedar Point one day and returning the next. The only flight from one body of land to another across the ocean that is comparable to McCurdy's is the flight made by the actor, Robert Lorraine, from England to Ireland, a distance of fifty-five miles above the Irish Sea. This flight was made last fall, and the aviator got within two hundred feet of shore when the machine descended in the water.

His Life in His Hands

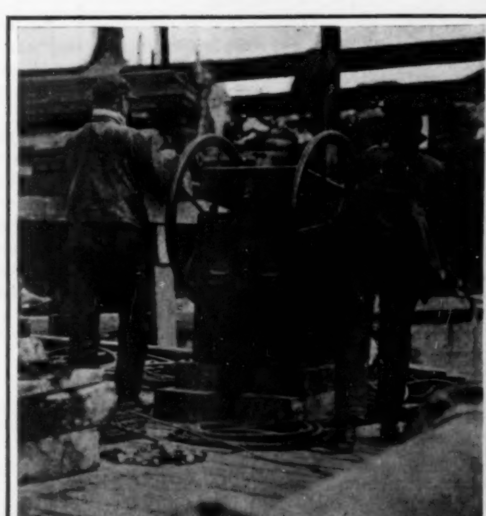
The Romantic Vocation of the Diver

By C. H. Claudy.

THE man who sighed for the romance of the days of knights in armor never went down fifteen fathoms in a diving suit. During the chivalric ages, men incased themselves in armor to do mortal combat with foes similarly equipped, and he who could best drive sword or lance through cold steel won the fight. But the man who incases himself in an armor of rubber and canvas, a helmet of metal such as Lancelot never wore, and shoes of lead, and goes down to fight the dangers of lack of air, entanglement in wreckage, unusual pressure, and all the other perils of life and limb which are to be found deep beneath the surface of sea or river, must have a courage and a quiet nerve beside which that of his ancient prototype is childish. For at least, the knight of old had light and air and freedom of speech and action; the knight of the rubber tube works in darkness, in an element foreign and inimical to life, and not only dangles his life loosely between his own fingers, but must put his trust for the very air he breathes in the hands of patient men above, slowly, ceaselessly, turning the wheels of an air pump.

Adjusting the helmet.

Fastening the yoke.



Working the air-pump.

Getting into the diving suit.

THE KNIGHT OF THE DEEP AND HIS ARMOR

It is surprising to learn how many uses there are for divers. The navy, of course, employs many, to set submarine mines and torpedoes and to attend to investigations of the condition of ships' bottoms. Every battleship has at least two highly-trained divers on her staff. Bridge construction companies use them in surveying for caissons, as do those who build dams, water works, and reservoirs. Water works in large cities keep a diver on their staff constantly, and he has plenty to do. Wrecking companies need their services constantly, the new profession of under-river tunneling makes many demands on the time and skill of the man in armor, and dock builders find it necessary to have a man willing to go beneath the surface in order to survey for pile setting, etc.

The profession of diving is more ancient than might be supposed. Aristotle speaks of men descending in water in a "kettle," and during the reign of Charles V., two Greeks descended in some sort of a diving bell, "bringing back with them, alight, and to the wonderment and awe of all, a candle lit before they descended."

But since Smeaton, in 1779, designed a pump to supply air to the diving bell, little real improvement in the art has been made, save in detail of helmet and clothes, until the invention of the telephone. The greatest advance ever made in the art, divers will tell you, is the combination of the telephone with the diving suit. Before its advent, divers had to depend entirely upon pulls on the life line for communication with the surface and upon signs to each other, when under water, if two wished to communicate. To-day the modern diving helmet is equipped with a telephone, and the diver can not only hear what is said to him from the surface, advise those in charge of his pump as to whether the air is "coming right" or not, and make reports as to the work in hand, but he can communicate to a brother diver and hear the instructions sent to him from the surface, all of which facilities are of great assistance in the work. At first thought, it may not seem so difficult a thing, this going down under water and breathing air sent in from a pump by a tube. But the physical drawbacks to the work, to take no account of the mental ones, are enormous. For every ten feet a diver descends, he sustains an added pressure of 4½ pounds over every square inch of his body. What this means may be better understood when considering the greatest depth ever made by a diver—204 feet. His body at that depth sustained a pressure of 88½ pounds to the square inch over and above the fifteen pounds always sustained when in the air.

Divers must descend very slowly, swallowing as they go. Otherwise they may bleed at the nose and ears and even lose consciousness. And they must ascend even more slowly than they descend, particularly when coming from great depths, otherwise they may, literally, burst from the internal air pressure. At the least, too sudden a rise may cause an attack of that terrible disease known to tunnel workers, called caisson disease, or "the bends," in which air gets into the tissues under pressure and causes the most extreme torture.

As may be imagined, divers must be healthy men to succeed in their work. Certain classes of men are never allowed to become divers by those who wish to train men for their work. Those always rejected for such service are: 1. Men with short necks, full-blooded, and florid complexions. 2. Men who suffer from headache, are slightly deaf, or have recently had a running from the ear. 3. Men who have at any time spat or coughed up blood. 4. Men who have been subject to palpitation of the heart. 5. Men who are very pale, whose lips are more blue than red, who are subject to cold hands and feet, men who have what is commonly known as a poor circulation. 6. Men who have bloodshot eyes and a high color on the cheek, by the interlacement of numerous small blood vessels, which are distinct. 7. Men who are hard drinkers and those who have suffered severely and repeatedly from blood poison, or who have had rheumatism or sunstroke.

Finally, divers must be strong men physically, for not only must they sustain pressure and work in heavy clothes with a great weight on their shoulders, but they must often exert much muscular force to move objects below the surface or to dig or tunnel their way into a wreck in search of what they are after. Of course, the weight a man bears on his shoulders and the heavy lead weights upon his feet make less inroads upon his strength when he is beneath the water; in fact, were it not for the weights, he would be more apt to rise to the surface than to stay down and work. But though the weight is made less by the surrounding water, that same water clogs his every effort and resists his motion, so that a two-hour spell ten fathoms down is exhausting to the most practised diver.

When a diver is to descend, he must make many preparations. He must not eat anything for two hours beforehand, to commence with, since, according to an eminent medical authority, "Men working subject to great pressure should not eat an ounce more of animal food than is absolutely necessary some time before descending, as it increases the tendency to apoplexy."

The diver, getting ready to descend, clothes himself in very heavy underwear of guernsey or flannel,

(*Continued on page 148.*)

Morning and Evening Stars for 1911

A Graphic Representation of Planetary Positions

By Prof. Frederic R. Honey, Trinity College

THE earth observer, from the egoistic vantage ground of his position, finds in the planets with their varying degrees of nearness and brilliancy, seven different stars of the morning and evening, which in their seemingly irrelevant changes keep their appointments with the observer in obedience to immutable law.

THE SUN AND PLANETS.

In a plot of the solar system, it is not possible to represent satisfactorily the orbits of all the planets to the same scale within the limits of this page. If Neptune's orbit were plotted to the maximum possible scale, making its diameter equal to nine and one-half inches, the diameter of Mercury's orbit, drawn to the same scale, would be reduced to about one-eighth of an inch. For this reason the orbits are plotted in two separate groups.

Plot 1 represents the orbits of the terrestrial planets, viz., those of Mercury, Venus, the Earth, and Mars, which are drawn to the same scale; and the orbits of the major planets, viz., Jupiter, Saturn, Uranus, and Neptune, are shown in Plot 2, in which the scale is very much reduced. The proportion between the two scales is easily determined by comparing the diameter of the orbit of the Earth or of Mars in Plots 1 and 2. The Sun is the only body whose dimensions are large enough to be appreciable in the drawing. In Plot 1 its diameter (=866,500 miles) would be represented by a little over one half of e—the distance between a the center of the Earth's orbit and the Sun's center; and the Earth's diameter by a measurement less than one-hundredth part of this distance. The diameter of the giant planet Jupiter is nearly one-tenth that of the Sun; and it is evident that it would shrink to a mere point in Plot 2. The plane of the ecliptic is the plane of the Earth's orbit, and for convenience of reference it may be considered as a horizontal plane. This is obviously an assumption, because in stellar space there is no plane of reference, and the words "horizontal" and "perpendicular" lose their significance; but it is convenient to speak of a planet or of a satellite as "above" or "below" the ecliptic. The orbits of the planets are ellipses with the Sun at one focus. The plots show the *projections* of the orbits on the plane of the ecliptic, which on account of their small angles of inclination, do not differ very much from their true forms. In the plot of each orbit that part which is above the ecliptic is represented by a full line; and the other part is below the ecliptic. The line of nodes N N' is the intersection of the plane of the orbit with that of the ecliptic. The ascending node N is the point where the planet passes from the space below to that above; and the descending node N' where it passes from the space above to that below. The point P is perihelion, or point of nearest approach to the sun.

THE TERRESTRIAL PLANETS.

PLOT 1.

MERCURY.

On account of the great eccentricity of the planet's orbit, Mercury's revolution around the Sun clearly illustrates the first two of Kepler's laws: 1st. *A planet moves in an elliptic orbit with the Sun as one focus.* 2d. *The radius vector* (or the line drawn from the Sun to the planet) *describes equal areas in equal times.* Mercury's orbit is inclined at an angle of 7 degrees, which is greater than that of any other planet either terrestrial or major. The eccentricity is also greater than that of the orbits of any other planets. The eccentricity is the distance from the center of the orbit to the Sun divided by the semi-major axis. The actual distance, or the linear eccentricity, is 7.4 million miles from the Sun to the center b. In obedience to the second law, the area of the triangle with the Sun as a vertex, and for a base that part of the orbit between the dates September 22nd and September 30th, is equal to the area of the triangle with the same vertex and a base equal to that part of the orbit between the dates August 5th and August 13th. The illustrations selected include perihelion and aphelion; and it is evident that in conformity with the law the planet's velocity varies between very wide limits. The velocities at perihelion and aphelion are respectively thirty-five and twenty-three miles per second. At a mean distance of thirty-six million miles, Mercury completes his revolution around the sun in very nearly eighty-eight days; and the positions of the planet are shown for every second day. In order to avoid confusion, the dates are given only for every eighth day. Intermediate positions and dates may be interpolated by subdivision. Since Mercury makes more than four revolutions during the year, four dates are attached to each position. The planet passes between the Earth and the Sun (inferior conjunction) four times during the year—on January 9th, May 5th, September 9th, and December 25th; and three times, viz., on March 20th, July 3rd, and October 23rd, the sun is between the earth and Mercury (superior conjunction).

VENUS.

The planet's orbit is inclined at an angle of 3.4 degrees; and the eccentricity, which is less than that of any

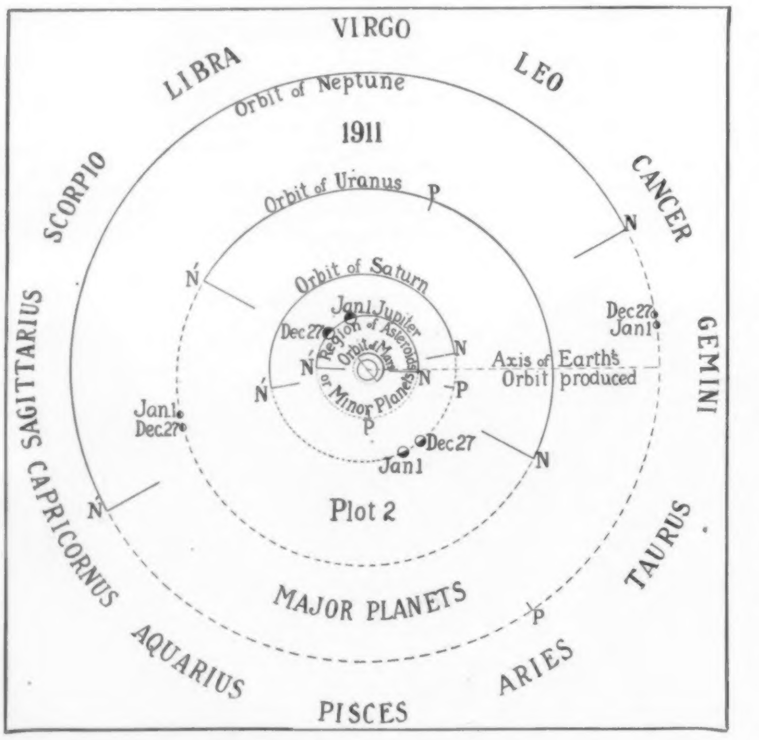


Fig. 2.—Orbits of the major planets.

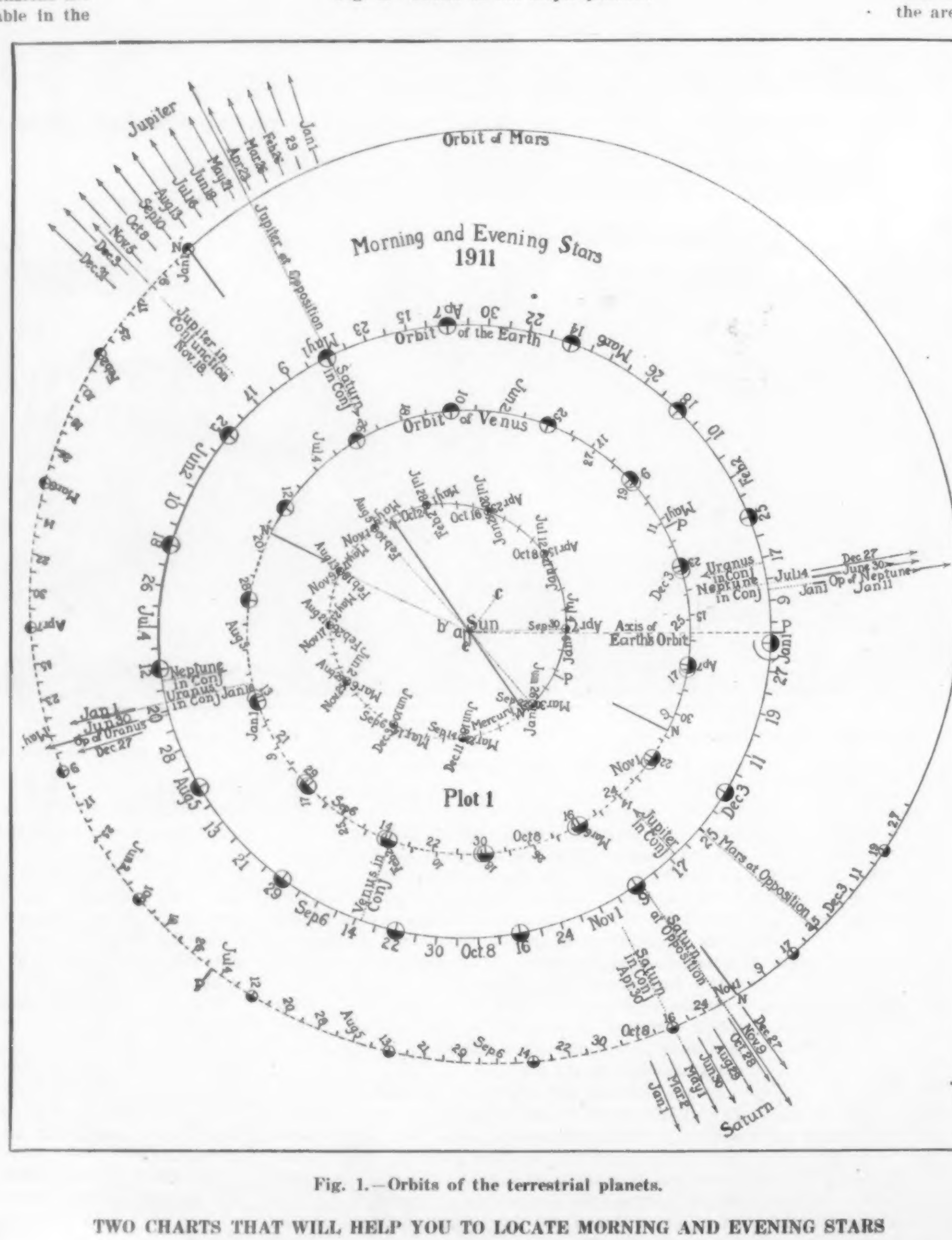


Fig. 1.—Orbits of the terrestrial planets.

TWO CHARTS THAT WILL HELP YOU TO LOCATE MORNING AND EVENING STARS

of the planets, is about a half a million miles—the position of the center of the orbit being scarcely distinguishable from the sun in the plot. As a consequence, the variations in the velocity are very small; and Venus revolves around the sun at a mean distance of 67.2 million miles with a velocity which is nearly uniform at the rate of 21.9 miles per second. The revolution is accomplished in 224 7/10 days. On August 13th the planet very nearly reaches the same position as that of January 1st. The difference is the distance traversed in seven-tenths of a day. The dates without the orbit refer to the first revolution; those within, to the second revolution. Venus is in inferior conjunction on September 15th. The position of the planet is shown for every fourth day.

THE EARTH.

The earth's orbit, which is in the plane of the ecliptic, has an eccentricity ($=e$) of about one and a half million miles. The mean distance from the Earth to the Sun, which is 92,900,000 miles, is diminished at perihelion in January and increased at aphelion in July, i. e., there is a total difference of a little over three million miles. Moving at an average velocity of 18½ miles per second, which is increased at perihelion and diminished at aphelion, the earth moves on the average nearly one degree daily $\frac{360}{365.25}$

The position is shown for every fourth day.

MARS.

The orbit is inclined to the ecliptic at an angle of 1.85 degrees; and the center of the orbit C is 13.2 million miles from the Sun. At a mean distance of 141.5 million miles, with a velocity of fifteen miles a second, Mars completes his revolution in 1.88 years. Mars is at opposition on November 24th.

THE ASTEROIDS OR MINOR PLANETS.

The purpose of this article is to show the positions of those planets which are visible to the naked eye. The asteroids occupy the space principally between the orbits of Mars and Jupiter. But the number is so great that a separate plot would be required to represent the orbits satisfactorily. Their positions are indicated in Plot 2.

THE MAJOR PLANETS.

Table 1 gives the inclinations of the orbits, the eccentricity, the distance from the Sun, the orbital velocity, and the period of revolution. Jupiter's position, as seen from the Sun, is indicated in Plot 1, at intervals of twenty-eight days; and in Plot 2 on January 1st and December 27th. The direction in which Saturn is seen in Plot 1 is shown at intervals of sixty days; and in Plot 2 on January 1st and December 27th. The apparent motions of Uranus and Neptune are so slow that it is only necessary to represent their directions at long intervals of time.

CONJUNCTIONS AND OPPOSITIONS.

The positions of the planets in Plot 1 are shown for Greenwich noon at intervals of four days; and, with the exception of Mercury, at the dates of conjunctions and oppositions, which are given in Table 2. The shorter arrow shows a conjunction; the longer arrow, an opposition. They are omitted in the plot at the dates of the Sun's conjunction with Mercury, in order to avoid confusion in the illustration. A planet whose orbit is within the Earth's orbit, is morning star between the dates of inferior and superior conjunctions, and evening star between the dates of superior and inferior conjunctions. A planet whose orbit is outside that of the Earth, is evening star before conjunction, and morning star after conjunction. It is both morning and evening star at the date of opposition. The plot should be turned around into a position where the Earth in the plot is between the reader and the Sun at the date when it is desired to ascertain the positions of the planets. A straight line drawn from the Earth to the Sun will divide the morning from the evening stars at this date. Those on the right will be morning stars, and those on the left evening stars.

TABLE 1.

Planet.	Inclination of Orbit. Deg.	Eccentricity, Million Miles.	Velocity, Miles per Second.	Distance, Million Miles.	Period, Years.
Jupiter	1.03	23.3	8.1	483.3	11.86
Saturn	2.5	49.7	6.0	886.0	29.46
Uranus	0.77	82.6	4.2	1781.9	84.02
Neptune	1.8	25.0	3.4	2791.6	164.78

TABLE 2.

Planet.	Conjunction.	Opposition.
Neptune......	July 14.37	Jan. 11.0
Uranus.......	Jan. 16.04	July 20.75
Saturn........	Apr. 30.75	Nov. 9.75
Jupiter.......	Nov. 18.12	Apr. 30.67
Mars........................		Nov. 24.71
Venus........	Sept. 15.0 (inf.)	
Mercury.......	Jan. 9.92 (inf.)	
Mercury......	Mar. 20.04 (sup.)	
Mercury......	May 5.25 (inf.)	
Mercury......	July 3.54 (sup.)	
Mercury......	Sept. 9.12 (inf.)	
Mercury......	Oct. 23.37 (sup.)	
Mercury......	Dec. 25.12 (inf.)	

As Others See Us

Comments on the Scientific American by Readers and Contemporaries

To the Editor of the SCIENTIFIC AMERICAN:

I am much pleased at the great improvement in the SCIENTIFIC AMERICAN in paper, type, and general make-up. It is a masterful piece of publishers' work and editorial excellence.

The SCIENTIFIC AMERICAN, which has for more than half a century been the greatest single scientific educator of the American people, ought to stand in the front rank of publications, not only in the respects in which it has so long stood, but in respect of the very guise in which it now goes to an appreciative public.

These newly embodied values are destined to come as a gift of the New Year and as a source of deep gratification to your thousands of admiring and appreciative readers, among whom I have been one since I could read, and among whom I expect to be one as long as my eyes last.

"Take the SCIENTIFIC AMERICAN" is a piece of advice fraught with blessings to those who take the advice.

Brooklyn, N. Y. HUDSON MAXIM.

To the Editor of the SCIENTIFIC AMERICAN:

Congratulations on the new dress and increased attractions. The paper, typography, pictures, contents, are all improved. I like the plan of giving portraits of distinguished scientists and inventors. The monthly page on astronomy is useful. C. W. LEFFINGWELL.

Garvanza, Cal.

To the Editor of the SCIENTIFIC AMERICAN:

I write to express my gratification and pleasure over the articles which you are publishing on the American Museum and the Zoological Park. The latter is really magnificent, and will help us enormously all over the country. HENRY FAIRFIELD OSBORN.

President New York Zoological Society.

New York, N. Y.

To the Editor of the SCIENTIFIC AMERICAN:

I have noticed a difference in the appearance of the SCIENTIFIC AMERICAN in the past few weeks, and certainly congratulate you upon its attractiveness.

Collier's Weekly. A. C. G. HAMMESFAHR.

To the Editor of the SCIENTIFIC AMERICAN:

I have come to look upon the SCIENTIFIC AMERICAN as little short of a necessity to a man who is mechanically inclined, and I get from it many times its cost in the course of a year. E. W. PARKER.

Columbia, S. C.

To the Editor of the SCIENTIFIC AMERICAN:

I beg to congratulate you on the great and beautiful improvement of the last edition of the SCIENTIFIC AMERICAN over *all its predecessors*. I think I am able to judge, as my recollection dates without a skip from about three years before your fire, until the present. I would like to see the improvement you will make in the next half century.

Sincerest desire for your continued prosperity.

New Haven, Conn. T. SAULT.

To the Editor of the SCIENTIFIC AMERICAN:

Its name is good enough and its scope is big enough to cover every human interest. I can see big possibilities in the SCIENTIFIC AMERICAN.

MILES B. HILLY,

Chicago, Ill. Lord & Thomas.

To the Editor of the SCIENTIFIC AMERICAN:

The changes of the general make-up of the SCIENTIFIC AMERICAN we think are a great improvement.

New York, N. Y. THE COE-MORTIMER COMPANY.

To the Editor of the SCIENTIFIC AMERICAN:

I have been getting your publication at home, and probably read it more carefully than I do any other weekly or monthly. F. B. SCHWARTZ,

Chicago, Ill. Charles H. Fuller Company.

To the Editor of the SCIENTIFIC AMERICAN:

I looked last night at the current copy of the SCIENTIFIC AMERICAN, and can certainly say that you are making progress in the direction of mechanical improvement.

Wishing you every success,

CHARLES D. LANIER,

New York, N. Y. Review of Reviews.

To the Editor of the SCIENTIFIC AMERICAN:

Allow me to congratulate you upon the physical appearance of the SCIENTIFIC AMERICAN of January 21st, which has just come to my desk.

It seems to me that this is an issue, irrespective of scientific considerations, which every man would want to read purely from the human interest standpoint.

STANLEY CLAGUE,

Chicago, Ill. Clague-Painter-Jones Company.

To the Editor of the SCIENTIFIC AMERICAN:

Ever since the beginning of the year, and the change in the appearance of the SCIENTIFIC AMERICAN, I have been intending to write you a note of commendation on it.

While I am greatly attached to old things, I must confess that the news columns and apparently new type, and at least the new setting of the SCIENTIFIC AMERICAN, is very pleasing to me. I have read the SCIENTIFIC AMERICAN for about forty-odd years, and it has kept up a very dignified and interesting and up-to-date record of the things "that are worth while" in the scientific world. I hope it will continue in as good shape, and progress with the times, as well as this last step indicates that it intends to.

I will also say that the additions to your advertising pages are quite worth while, as the advertising is of a character that is of interest to scientific men.

ARTHUR H. ELLIOTT,

New York, N. Y. Consulting Engineer-Chemist.

The Marine Journal congratulates its esteemed contemporary the SCIENTIFIC AMERICAN upon reaching the sixty-seventh year of its publication with the beginning of 1911. The establishment of this journal at the time when the development of the railroad, the steamship, and the telegraph were in their infancy was particularly timely, and the fact that its circulation has reached out from a merely local weekly to a journal read throughout the whole English-speaking world today proves that it has fully covered its chosen field.—*Marine Journal.*

The SCIENTIFIC AMERICAN has filled out sixty-six years, and still is as fresh and young and strong as it ever was during these more than threescore years of life. During the past of its existence it has been enlarged from time to time, adding to the scope of its simplified science, making it not only understandable but fascinating to the layman, and stating its great facts and principles in good, clear, plain English. To many it has become a necessity, and we do not know of any one of intelligence who does not delight to look over its pages, and who is not sure to find something of interest. The number of men it has instructed is legion. It has been a great schoolmaster in mechanics, practical achievement, and knowledge of mechanical science. It takes on larger scope in the beginning of the new year; recasts its make-up in typography, which will make it even more popular than in the past; adds to its pages, and issues a monthly appendix, and all for the same price; but it will still hold to its standard of accuracy and authority.—From *Signs of the Times* (California).

Among the most highly valued periodicals which come to the editor's desk is the SCIENTIFIC AMERICAN, and, as our readers know, we frequently quote from it or reprint from it, thus giving subscribers to *The Advance* the benefit of a little of the important scientific information which fills its pages from week to week. Our contemporary celebrates the beginning of its sixty-seventh year by increasing the size of its regular issue to twenty-four pages and by the use of a more attractive style of headings and make-up which make it even more appealing than heretofore, and it promises even better material—a promise which it will be difficult to keep. May this useful journal continue to enjoy its increasing popularity.—*The Presbyterian Advance.*

Science in the Current Periodicals

In this Department the Reader will find Brief Abstracts of Interesting Articles Appearing in Contemporary Periodicals at Home and Abroad

A Scientist on Golf Science

TO the casual looker-on there is a fascination in watching the graceful flight of the golf ball. To the devotee of the game, the tricks and whims of the soaring sphere have a peculiar and special interest. But from a scientific point of view also, the phenomena presented by the projectile shot from the golfer's club present problems of interest.

The subject of the flight of the golf ball, treated from the point of view of physics, formed the theme of an address delivered by Professor Sir J. J. Thomson before the Royal Institution. We quote here the eminent physicist in his own words:

"If we could send off the ball from the club without spin, its behavior would be regular, but uninteresting; in the absence of wind its path would keep in a vertical plane; it would not deviate either to the right or to the left, and would fall to the ground after a comparatively short carry.

"But a golf ball when it leaves the club is only in rare cases devoid of spin, and it is spin which gives the interest, variety, and vivacity to the flight of the ball. It is spin which accounts for the behavior of a sliced or pulled ball, it is spin which makes the ball soar or 'duck,' or execute those wild flourishes which give the impression that the ball is endowed with an artistic temperament, and performs these eccentricities as an acrobat might throw in an extra somersault or two for the fun of the thing. This view, however, gives an entirely wrong impression of the temperament of a golf ball, which is, in reality, the most prosaic of things, knowing while in the air only one rule of conduct, which it obeys with unintelligent conscientiousness, that of always following its nose. This rule is the key to the behavior of all balls when in the air, whether they are golf balls, base balls, cricket balls, or tennis balls. Let us, before entering into the reason for this rule, trace out some of its consequences. By the nose of the ball we mean the point on the ball farthest in front. Thus if, as in Fig. 1, C the center of the ball is moving horizontally to the right, A will be the nose of the ball; if it is moving horizontally to the left, B will be the nose. If it is moving in an inclined direction CP, as in Fig. 2, then A will be the nose.

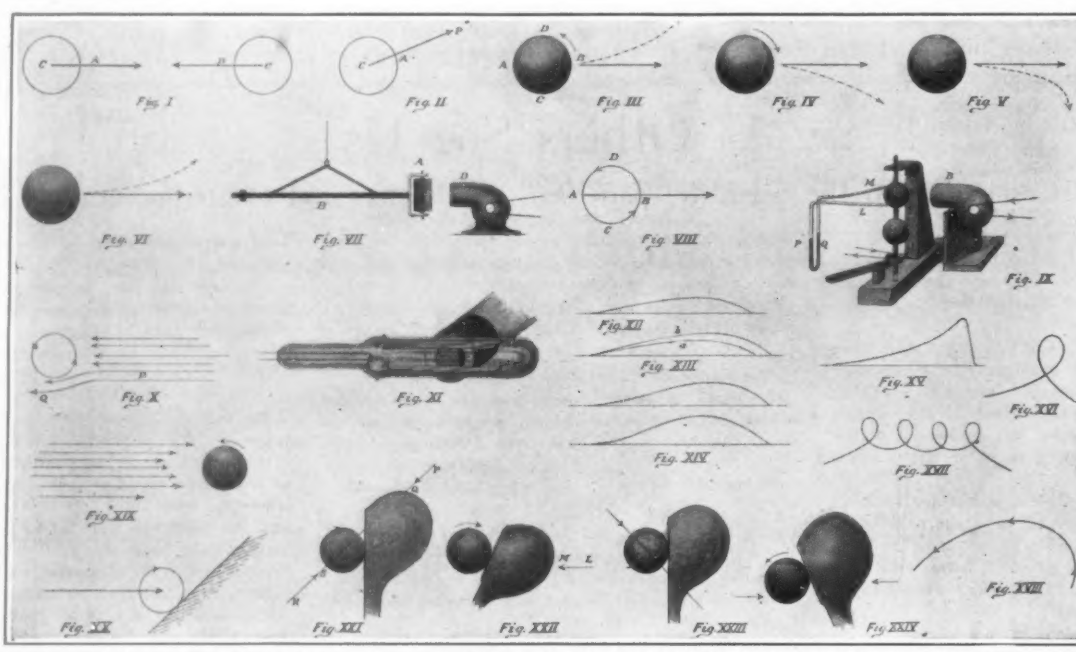
"Now let the ball have a spin on it about a horizontal axis, and suppose the ball is traveling horizontally as in Fig. 3, and that the direction of the spin is as in the figure, then the nose A of the ball is moving upward, and since by our rule the ball tries to follow its nose, the ball will rise and the path of the ball will be curved as in the dotted line. If the spin on the ball, still about a horizontal axis, were in the opposite direction, as in Fig. 4, then the nose A of the ball would be moving downward, and as the ball tries to follow its nose it will duck downward, and its path will be like the dotted line in Fig. 4.

"Let us now suppose that the ball is spinning about a vertical axis, then if the spin is as in Fig. 5, as we look along the direction of the flight of the ball the nose is moving to the right; hence by our rule the ball will move off to the right, and its path will resemble the dotted line in Fig. 5; in fact, the ball will behave like a sliced ball. Such a ball, as a matter of fact, has spin of this kind about a vertical axis.

"If the ball spins about a vertical axis in the opposite direction, as in Fig. 6, then, looking along the line of flight, the nose is moving to the left, hence the ball moves off to the left, describing the path indicated by the dotted line; this is the spin possessed by a 'pulled' ball. If the ball were spinning about an axis along the line of flight, the axis of spin would pass through the nose of the ball, and the spin would not affect the motion of the nose; the ball, following its nose, would thus move on without deviation.

"Thus, if a cricket ball were spinning about an axis parallel to the line joining the wickets, it would not swerve in the air; it would, however, break in one way or the other after striking the ground; if, on the other hand, the ball were spinning about a vertical axis, it would swerve while in the air, but would not break on hitting the ground. If the ball were spinning about an axis intermediate between these directions, it would both swerve and break.

"Excellent examples of the effect of spin on the flight of a ball in the air are afforded in the game of base ball; an expert pitcher, by putting on the appropriate spins, can make the ball curve either to the right or to the left, upward or downward; for the sideway curves the spin must be about a vertical axis, for the upward or downward ones about a horizontal axis.



THE DYNAMICS OF A GOLF BALL. A SERIES OF PICTURES THAT SHOW WHY GOLF IS NOT AN EASY GAME

"Before proceeding to the explanation of this effect of spin, I will describe some experiments which illustrate the point we are considering. As the forces acting on the ball depend on the *relative* motion of the ball and the air, they will not be altered by superposing the same velocity on the air and the ball; thus, suppose the ball is rushing forward through the air with the velocity V, the forces will be the same if we superpose on both air and ball a velocity equal and opposite to that of the ball; the effect of this is to reduce the center of the ball to rest, but to make the air rush past the ball as a wind moving with the velocity V. Thus the forces are the same when the ball is moving and the air at rest, or when the ball is at rest and the air moving. In lecture experiments it is not convenient to have the ball flying about the room; it is much more convenient to keep the ball still and make the air move.

"The first experiment I illustrate is one made by Magnus in 1852; its object is to show that a rotating body moving relatively to the air is acted on by a force in the direction in which the nose of the body is moving relatively to its center; the direction of this force is thus at right angles both to the direction in which the center of the body is moving and also to the axis about which the body is spinning. For this purpose a cylinder A (Fig. 7) is mounted on bearings so that it can be spun rapidly about a vertical axis; the cylinder is attached to one end of the beam B, which is weighted at the other end, so that when the beam is suspended by a wire it takes up a horizontal position.

"The beam yields readily to any horizontal force, so that if the cylinder is acted on by such a force this will be indicated by the motion of the beam. In front of the cylinder there is a pipe D, through which a rotating fan driven by an electric motor sends a blast of air which can be directed against the cylinder. The beam carrying the cylinder is adjusted so that the blast of air strikes the cylinder symmetrically; in this case, when the cylinder is not rotating, the impact against it of the stream of air does not give rise to any motion of the beam. If, however, the cylinder is set spinning, then as soon as the blast strikes against it the beam moves off sideways. It goes off one way when the spin is in one direction, and in the opposite way when the direction of spin is reversed. The beam rotates in the same direction as the cylinder, which is just what it would do if the cylinder were acted upon by a force in the direction in which its nose (which, in this case, is the point on the cylinder first struck by the blast) is moving.

"We shall now pass on to the consideration of how these forces arise. They arise because when a rotating body is moving through the air the pressure of the air on one side of the body is not the same as that on the other; the pressures on the two sides do not balance, and thus the body is pushed away from the side where the pressure is greatest.

"Thus, when a golf ball is moving through the air, spinning in the direction shown in Fig. 8, the pressure on the side ABC, where the velocity due to the spin conspires with that of translation, is greater than that on the side ADB, where the velocity due to the spin is in the opposite direction to that due to the translatory motion of the ball through air.

"It is easy to show by an experiment that this is the case, and also that the difference between the pressure on the two sides of the golf ball depends upon the roughness of the ball.

"In the instrument shown in Fig. 9 two golf balls, one smooth and the other having the ordinary bramble markings, are mounted on an axis, and can be set in rapid rotation by an electric motor. An air-blast produced by a fan comes through the pipe B, and can be directed against the balls; the instrument is provided with an arrangement by which the supports of the axis carrying the balls can be raised or lowered so as to bring either the smooth or the bramble-marked ball opposite to the blast. The pressure is measured in the following way: LM are two tubes connected with the pressure-gage PQ; L and M are placed so that the golf balls can just fit in between them; if the pressure of the air on the side M of the balls is greater than that of the side L, the liquid on the right-hand side Q of the pressure-gage will be depressed; if, on the other hand, the pressure at L is greater than that at M, the left-hand side P of the gage will be depressed.

"I first show that when the golf balls are not rotating there is no difference in the pressure on the two sides when the blast is directed against the balls; you see there is no motion of the liquid in the gage. Next I stop the blast and make the golf balls rotate; again there is no motion in the gage. Now when the golf balls are spinning in the direction indicated in Fig. 9 I turn on the blast, the liquid falls on the side Q of the gage, rises on the other side. Now I reverse the direction of rotation of the balls, and you see the motion of the liquid in the gauge is reversed, indicating that the high pressure has gone from one side to the other. You see that the pressure is higher on the side M, where the spin carries this side of the ball into the blast, than on L, where the spin tends to carry the ball away from the blast. If we could imagine ourselves on the golf ball, the wind would be stronger on the side M than on L, and it is on the side of the strong wind that the pressure is greatest. The case when the ball is still and the air moving from right to

left is the same from the dynamical point of view as when the air is still and the ball moves from left to right; hence we see that the pressure is greatest on the side where the spin makes the velocity through the air greater than it would be without spin.

THE SMOOTH BALL AND THE ROUGH.

"To show the difference between the smooth ball and the rough one, I bring the smooth ball opposite the blast; there is a difference between the levels of the liquid in the two arms of the gage. I now move the rough ball into the place previously occupied by the smooth one, and the difference of the levels is more than doubled, thereby showing that with the same spin and speed of air blast the difference of pressure for the rough ball is more than twice that for the smooth.

"We must now go on to consider why the pressure of the air on the two sides of the rotating ball should be different. The gist of the explanation was given by Newton nearly 250 years ago. Writing to Oldenburg in 1671 about the dispersion of light, he says, in the course of his letter: 'I remembered that I had often seen a tennis ball struck with an oblique racket describe such a curved line. For a circular as well as progressive motion being communicated to it by that stroke, its parts on that side where the motions conspire must press and beat the contiguous air more violently, and there excite a reluctancy and reaction of air proportionately greater.' The same explanation was given by Magnus, and the mathematical theory of the effect is given by Lord Rayleigh in his paper on 'The Irregular Flight of a Tennis Ball,' published in the *Messenger of Mathematics*, vol. vi., p. 14, 1877. Lord Rayleigh shows that the force on the ball resulting from this pressure difference is at right angles to the direction of motion of the ball, and also to the axis of spin, and that the magnitude of the force is proportional to the velocity of the ball multiplied by the velocity of spin, multiplied by the sine of the angle between the direction of motion of the ball and the axis of spin.

"Let us consider a golf ball (Fig. 10) rotating in a current of air flowing past it. The air on the lower side of the ball will have its motion checked by the rotation of the ball, and will thus in the neighborhood of the ball move more slowly than it would do if there were no golf ball present, or than it would do if the golf ball were there but were not spinning. Thus if we consider a stream of air flowing along the channel *PQ*, its velocity when near the ball at *Q* must be less than its velocity when it started at *P*; there must, then, have been pressure acting against the motion of the air as it moved from *P* to *Q*., i. e., the pressure of the air at *Q* must be greater than at a place like *P*, which is some distance from the ball. Now let us consider the other side of the ball; here the spin tends to carry the ball in the direction of the blast of air; if the velocity of the surface of the ball is greater than that of the blast, the ball will increase the velocity of the blast on this side; and if the velocity of the ball is less than that of the blast, though it will diminish the velocity of the air, it will not do so to so great an extent as on the other side of the ball. Thus the increase in pressure of the air at the top of the ball over that at *P*, if it exists at all, will be less than the increase in pressure at the bottom of the ball. Thus the pressure at the bottom of the ball will be greater than that at the top, so that the ball will be acted on by a force tending to make it move upward.

"We have supposed here that the golf ball is at rest, and the air rushing past it from right to left; the forces are just the same as if the air were at rest, and the golf ball rushing through it from left to right. As in Fig. 10, such a ball rotating in the direction shown in the figure will move upward, i. e., it will follow its nose.

SPINNING AND AIR PRESSURE.

"The difference between the pressures on the two sides of the golf ball is proportional to the velocity of the ball multiplied by the velocity of the spin. As the spin imparted to the ball by a club with a given loft is proportional to the velocity with which the ball leaves the club, the difference of pressure when the ball starts is proportional to the square of its initial velocity. The difference between the average pressures on the two sides of the ball need only be about one-fifth of one per cent of the atmospheric pressure to produce a force on the ball greater than its weight. The ball leaves the club in a good drive with a velocity sufficient to produce far greater pressures than this. The consequence is that when the ball starts from the tee spinning in the direction shown in Fig. 3—this is often called underspin—the upward force due to the spin is greater than its weight, thus the resultant force is upwards, and the ball is repelled from the earth instead of being attracted to it. The consequence is that the path of the ball curves upward instead of downwards, which would be its path if it had no spin. The spinning golf ball is, in fact, a very efficient heavier-than-air flying machine; the lifting force may be many times the weight of the ball.

"The path of the golf ball takes very many interesting forms as the amount of spin changes. We can trace all these changes in the arrangement which I have here, and which I might call an electric golf links. With this apparatus I can subject small particles to forces of exactly the same type as those which act on a spinning golf ball. These particles start from what may be called the tee *A* (Fig. 11). This is a red-hot piece of platinum with a spot of barium oxide upon it; the platinum is connected with an electric battery which causes negatively electrified particles to fly off the barium and travel down the glass tube in which the platinum strip is contained; nearly all the air has been exhausted from this tube. These particles are luminous, so that the path they take is very easily observed. We have now got our golf balls off from the tee; we must now introduce a vertical force to act upon them to correspond to the force of gravity on the golf ball. This is easily done by the horizontal plates *BC*, which are electrified by connecting them with an electric battery; the upper one is electrified negatively, hence when one of these particles moves between the plates it is exposed to a constant downward force, quite analogous to the weight of the ball. You see now when the particles pass between the plates their path has the shape shown in Fig. 12; this is the path of a ball without spin. I can imitate the effect of spin by exposing the particles while they are moving to magnetic force, for the theory of these particles shows that when a magnetic force acts upon them it produces a mechanical force which is at right angles to the direction of motion of the particles, at right angles also to the magnetic force, and proportional to the product of the velocity of the particles, the magnetic force, and the sine of the angle between them. We have seen that the force acting on the golf ball is at right angles to the direction in which it is moving at right angles to the axis of spin, and proportional to the product of the velocity of the ball, the velocity of spin, and the sine of the angle between the velocity and the axis of spin. Comparing these statements, you will see that the force on the particle is of the same type as that on the golf ball if the direction of the magnetic force is along the axis of spin and the magnitude of the force proportional to the velocity of spin, and thus if we watch the behavior of these particles when under the magnetic force we shall get an indication of the behavior of the spinning golf ball. Let us first consider the effect of underspin on the flight of the ball; in this case the ball is spinning, as in Fig. 3, about a horizontal axis at right angles to the direction of flight. To imitate this spin I must apply a horizontal magnetic force at right angles to the direction of flight of the particles. I can do this by means of the electromagnet. I will begin with a weak magnetic force, representing a small spin. Observe how the path differs from the one when there was no magnetic force; the path, to begin with, is flatter, though still concave, and the carry is greater than before—see Fig. 13*a*. I now increase the strength of the magnetic field, and the carry is still further increased, Fig. 13*b*. I increase the spin still further, and the initial path becomes convex instead of concave, with a still further increase in carry, Fig. 14. Increasing the force still more, and the particle soars to a great height, then comes suddenly down, the carry now being less than in the previous case (Fig. 15). This is still a familiar type of the path of the golf ball. I now increase the magnetic force still further, and now we get a type of flight not to my knowledge ever observed in a golf ball, but which would be produced if we could put on more spin than we are able to do at present. There is a kink in the curve, and at one part of the path the particle is actually traveling backward (Fig. 16). Increasing the magnetic force I get more kinks, and we have a type of drive which we have to leave to future generations of golfers to realize (Fig. 17).

"By increasing the strength of the magnetic field I can make the curvature so great that the particles fly back behind the tee, as in Fig. 18.

"Though the kinks shown in Fig. 15 have never, so far as I am aware, been observed on a golf links, it is quite easy to produce them if we use very light balls. I have here a ball made of very thin India rubber of the kind used for toy balloons, filled with air, and weighing very little more than the air it displaces; on striking this with the hand, so as to put underspin upon it, it describes a loop, as in Fig. 16.

"Striking the ball so as to make it spin about a vertical axis, causes it to move off with a most exaggerated slice when its nose is moving to the right looking at it from the tee, and with an equally pronounced pull when its nose is moving to the left.

"The general effect of wind upon the motion of a spinning ball can easily be deduced from the principles already discussed. Take, first, the case of a head-wind. This wind increases the relative velocity of the ball with respect to the air; since the force due to the spin is proportional to this velocity, the wind increases this force, so that the effects due to spin are more pronounced when there is a head-wind than on a calm day. All golfers must have had only too many opportunities of noticing this.

"Let us now consider the effect of a cross-wind. Suppose the wind is blowing from left to right, then, if the ball is pulled, it will be rotating in the direction shown in Fig. 19; the rules we found for the effect of rotation on the difference of pressure on the two sides of a ball in a blast of air show that in this case the pressure on the front half of the ball will be greater than that on the rear half, and thus tend to stop the flight of the ball. If, however, the spin was that for slice, the pressure on the rear half would be greater than the pressure in front, so that the difference in pressure would tend to push on the ball and make it travel further than it otherwise would. The moral of this is that if the wind is coming from the left we should play up into the wind and slice the ball, while if it is coming from the right we should play up into it and pull the ball.

HOW THE BALL GETS ITS SPIN.

"I have not space for more than a few words as to how the ball acquires the spin from the club. But if you grasp the principle that the action between the club and the ball depends only on their *relative* motion, and that it is the same whether we have the ball fixed and move the club or have the club fixed and project the ball against it, the main features are very easily understood.

"Suppose Fig. 20 represents the section of the head of a lofted club moving horizontally forward from right to left, the effect of the impact will be the same as if the club were at rest and the ball were shot against it horizontally from left to right. Evidently, however, in this case the ball would tend to roll up the face, and would thus get spin about a horizontal axis in the direction shown in the figure; this is underspin, and produces the upward force which tends to increase the carry of the ball.

"Suppose, now, the face of the club is not square to its direction of motion, but that, looking down on the club, its line of motion when it strikes the ball is along *PQ* (Fig. 21), such a motion as would be produced if the arms were pulled in at the end of the stroke, the effect of the impact now will be the same as if the club were at rest and the ball projected along *RS*, the ball will endeavor to roll along the face away from the striker; it will spin in the direction shown in the figure about a vertical axis. This, as we have seen, is the spin which produces a slice. The same spin would be produced if the motion of the club were along *LM* and the face turned so as to be in the position shown in Fig. 22, i. e., heel in front of toe.

"If the motion and position of the club were as in Figs. 23 and 24, instead of as in Figs. 21 and 22, the same consideration would show that the spin would be that possessed by a pulled ball."

Nova Sagittarii, No. 3

THE following statement of the results of her observations is published in a circular issued by Harvard College Observatory by Miss Cannon, the discoverer of the new star "Nova 3" in Stagittarius:

"Nova Sagittarii, No. 3, was found while examining a plate taken at Arequipa on September 6th, 1899, with the one-inch Cooke lens. As is customary with the writer, when a new variable star is found, a number of photographs taken in different years were examined to determine something of the character of the variation. The peculiar nature of the light curve was soon evident. An examination was therefore made of a large number of photographs taken between June 7th, 1889, and September 3rd, 1910. The object is visible on twenty-seven photographs taken with six different telescopes, between August 10th, 1899, and October 3rd, 1901. It is not seen on 112 other photographs, including three in 1889, one in 1890, two in 1891, five in 1893, nine in 1895, eight in 1896, three in 1897, two in 1898, fifteen in 1902, eight in 1903, ten in 1904, seven in 1905, eight in 1906, nine in 1907, eight in 1908, seven in 1909, and seven in 1910.

"Although no spectrum of this star was obtained, the suddenness of the outburst, and the form of the light curve, leave no doubt as to the character of the object. The star is not visible on photographs taken August 5th, 6th, 7th, and 9th, 1899. On the plate taken August 9th, 1899, G.M.T. 14h. 24m. an adjacent star of magnitude 11.4 is present, but there is no trace of the Nova. The plate taken the next evening, August 10th, 1899, G.M.T. 12h. 28m., shows the new star at full brightness. On August 23rd, the magnitude was about the same, and it appears probable that it may have been brighter during the interval between August 10th and August 23rd. The light faded rapidly at first but was nearly stationary and of magnitude 12.0 from April to July, 1900. It then

decreased slowly, and was magnitude 13.3 on October 3rd, 1901. Since that time, it has not been seen, unless we assume that the faint object on the Bruce plates is identical with the Nova."

What Produces the Aurora Borealis?

A VERY interesting paper on this subject was read before the Congress of Mathematics at Rome by Prof. C. Stoermer. We quote here the most essential parts of his lecture:

"In 1896 Birkeland discovered that cathode rays are attracted and converged toward the pole of a very powerful magnet (Fig. 1). This result, which, as Poincaré has shown, is in perfect accordance with the mathematical theory of the motion of an electric corpuscle in a magnetic field, led Birkeland to form a fertile theory of the origin of the aurora borealis. In the same year Birkeland, after citing Paulsen's hypothesis that the aurora borealis is due to phosphorescence of the air caused by cathode rays coming from the highest atmospheric strata, announced his conclusion that these rays originate outside the atmosphere, are produced in some way by the sun, and are absorbed principally at the terrestrial magnetic pole.

Fig. 1.—Cathode rays converged by a magnet.

"Birkeland has since conducted three expeditions to the Arctic for the purpose of studying the aurora and the magnetic perturbations, and has performed some remarkable experiments which give support to his theory.

"Fig. 2 illustrates an experiment in which a magnetized sphere, representing the earth, and coated with phosphorescent barium platino-cyanide, became surrounded with a luminous ring when it was suspended in a stream of cathode rays. With a very small and very highly magnetized sphere, two luminous rings, encircling the magnetic poles and corresponding to the belts of maximum frequency of auroras, were obtained (Fig. 3).

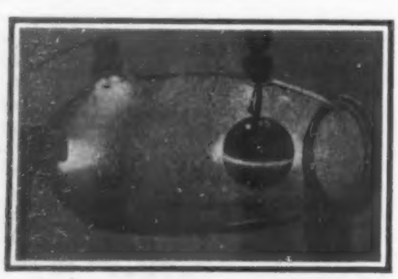


Fig. 2.—Magnetic sphere in cathode rays.

"Stoermer has developed the mathematical theory of this phenomenon, and, in a series of researches extended over four years and involving more than 5,000 hours of actual computation by himself and his assistants, has obtained results which explain the principal phenomena observed by Birkeland and many of the characteristic features of auroras and magnetic perturbations.

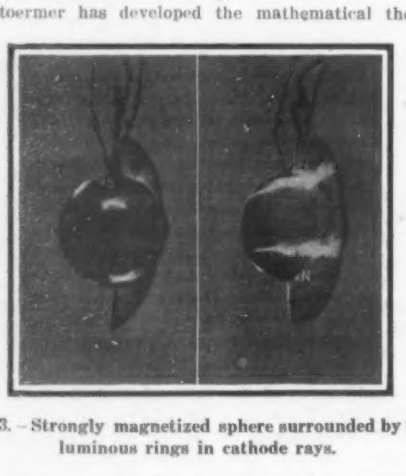


Fig. 3.—Strongly magnetized sphere surrounded by two luminous rings in cathode rays.

"Stoermer's task consisted essentially in determining, from the known laws governing the motion of a cathode particle in a magnetic field, the trajectories of electric corpuscles emanating from the sun, as affected by the earth, regarded as an elementary magnet. A model representing a bundle of such trajectories, or rays, is shown in Fig. 4.

"The particles, deflected from their rectilinear course by the earth's magnetic influence, sweep round the earth and strike it, or its atmosphere, in almost every part of a ring encircling the pole. This explains the production of auroras at night when the sun is on the opposite side of the earth. In general, the paths of the particles are not plane curves, but are curves of three dimensions, as appears more clearly from the model shown in Fig. 5. Owing to the comparative smallness of the earth and the fact that the sun's angular distance from the terrestrial magnetic equator never exceeds 35 deg., only those particles that are projected from the sun, at any given time, in or approximately in certain definite directions, reach the earth or its atmosphere. Hence the theoretical auroral zones are limited to rings encircling the earth's magnetic poles, in positions which closely correspond to the observed belts of maximum frequency of auroras.

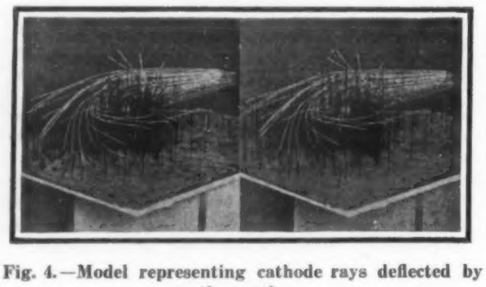


Fig. 4.—Model representing cathode rays deflected by the earth.

"Let us now consider a very narrow pencil of cathode or other electrical rays emanating from a single point of the sun in directions nearly parallel to one of the definite directions mentioned above. The theory shows that these rays, after entering the earth's atmosphere, will form helices about a line of magnetic force. The result will be a typical auroral "ray" or "streamer," the thickness of which will vary, according to the character of the original solar rays, from a few yards for cathode rays to several miles for the Alpha rays of radium.

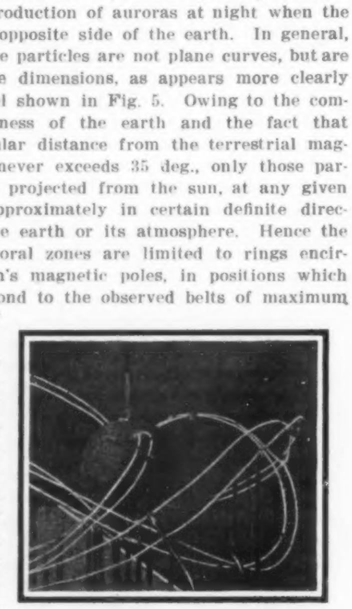


Fig. 5.—Model representing cathode rays deflected by the earth.

"If the point of emanation of the solar rays is shifted slightly, the resultant auroral ray will be shifted correspondingly, and its displacement can be calculated from the mathematical theory. Hence it is possible to determine by calculation the entire region of the atmosphere that is hit by corpuscles emanating from any given area of the sun's surface. The result gives a very natural explanation of the peculiar and beautiful phenomena called auroral draperies, which are illustrated in Fig. 6. The calculation shows that for certain positions of the emanating surface with respect to the magnetic axis a pencil of rays of originally circular cross section is enormously extended, in a direction perpendicular to the magnetic axis, as it approaches the earth, so that within the atmosphere it forms a very wide and thin sheet of auroral drapery. For example, in a special case, in which the emanating surface is assumed to extend 3 minutes of an arc parallel to the earth's magnetic rays, the drapery is 170 miles wide and 238 feet thick. The theory also explains the remarkable phenomenon of multiple draperies, illustrated in Fig. 6."

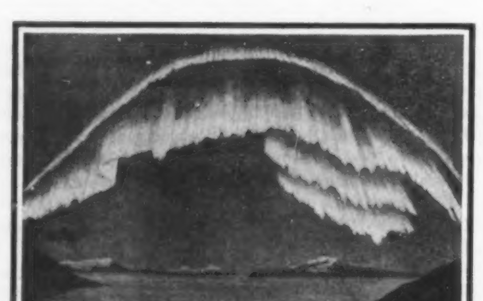


Fig. 6.—Auroral draperies.

The Cause of Squint

IT is a matter of common knowledge that the affection of sight popularly described as a squint, and technically termed "strabismus," can frequently be remedied by surgical measures. It is also fairly well known that the operation does not always give such complete success as might be desired. The underlying reason for the occasional failures, and the entire *rationale* of the medical and surgical treatment of the disorder, are, however, less generally understood. The subject has been lucidly discussed by Prof. Bielschowski in *Die Umschau*. Strabismus may have its cause in a variety of circumstances, and the treatment proper for one case may be quite unadapted to another. The matter is simplest when the cause of the trouble is purely mechanical, and resides in the muscles of the eyeball, which are abnormal in their relative development. These are the cases readily amenable to surgical treatment, and if failure results from an operation in a simple case of this kind, it may be due to lack of skill on the part of the surgeon. But strabismus may occur through entirely different causes. When we fix our gaze upon any comparatively near object, our eyes must undergo two adjustments. First so-called "accommodation" is called into play, whereby the lens of the eye is modified to correspond to the distance of the object from the eye so that a sharply focused image is formed upon the retina. But at the same time it is necessary for the two eyes to assume the right position of "convergence," such that the two images of the object looked at may appear upon corresponding portions of the retina of the right and the left eye. Now the nervous mechanism which controls these adjustments is such that there is a direct relation between the two actions. Hence if a person's accommodation is abnormal, as in far-sighted or short-sighted individuals, a condition of accommodation which should normally be associated with comparatively high convergence, as in looking at a near object, now becomes necessary in viewing an object at a far distance. The result is that the eyes are made to converge as if they were viewing a near object, or in other words there is an inward squint produced. These relations are most readily understood by reference to the accompanying diagram. A person with normal sight, fixing his gaze on some object *A* (Fig. 1) receives upon corresponding portions of the retinas of his two eyes a clear image of *A*. The conditions are much the same when he views a near object *B*, except that now the axes of his eyes converge more closely (Fig. 2). A far-sighted person, however, looking at *A* (Fig. 3) has to accommodate his lenses to the same extent as the normal eye in looking at *B*. With this strong accommodation effort there is associated such a high convergence of the axes of the eyes, that he can view *A* only with one eye, while the other eye necessarily looks across the line of vision of the first; there is a squint produced, and the images on the retinas of the two eyes do not properly correspond. It is quite obvious that surgical intervention, which consists in weakening the pull of certain of the muscles, is quite out of place here. Such an operation may for a time in a measure remedy the inward squint accompanying the viewing of a near-by object, but will tend to introduce in its place an outward squint under ordinary conditions. The remedy would be worse than the disease. The proper treatment in such a case is to prescribe proper eyeglasses for the patient.

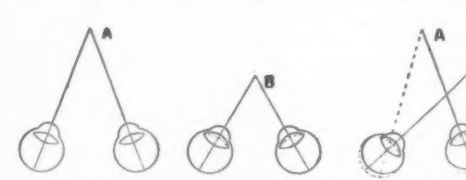


Fig. 1. Fig. 2. Fig. 3.

Fig. 1.—Normal eyes viewing a moderately distant object. Fig. 2.—Normal eyes viewing a near object. Fig. 3.—Far-sighted eyes viewing a moderately distant object, and squint induced owing to abnormal convergence required.

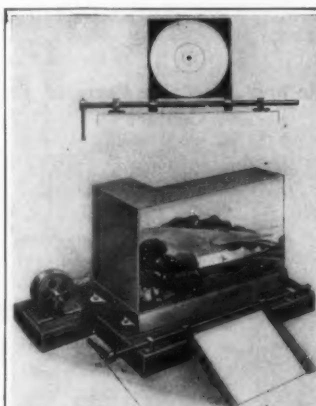
There is a third type of strabismus, which is due to nervous disorders. Here also surgical treatment would be quite out of place, and, if applied, may lead to very undesirable and unpleasant results, which, it is true, can usually be rectified by a second operation if by this time the patient has not lost his confidence in his medical adviser.

The subject presents some rather complex problems, and the patient who values his eyesight will take care to put his case into the hands of a thoroughly competent physician.

An Electric Recording Rifle Range Target

By the English Correspondent of the Scientific American

MILITARY circles in Europe have been recently deeply interested in a new electric recording target suitable for rifle ranges, that has been perfected by an Australian inventor, Mr. S. A. M. Rose, with which demonstrations were recently carried out in London. The remarkable strides that have been made in the range and speed of firing in service rifles have



Scenic recording target for moving objects. Bull's eye swung down.

necessitated an improved form of target and better methods for recording the shots. To this end several automatically recording targets have been devised, but they have not proved completely satisfactory, it having been found impossible to indicate with the requisite accuracy the precise location of every shot hole in the target. In this direction the new apparatus is a distinct improvement, for it gives infallibly the actual point where the shot has hit the target, and where extremely accurate shooting is demanded, has proved far superior to any system yet devised.

The apparatus can be applied with equal facility to any desired range, whether it be an indoor range where miniature rifles are used, or an outdoor range varying from 25 to 2,000 yards. It can be used either with a stationary bull's eye target or with a moving target. In this latter instance its utility is enhanced, inasmuch as it not only shows the "hits," but the "misses" as well, so that a reliable idea of a rifleman's marksmanship can be instantly determined. Simplicity is another outstanding feature, only three wires being necessary.

The accompanying illustrations explain the design and operation of the apparatus. The object target shown comprises a frame at the back of which are set up vertical rollers carrying a drum of paper or other material which is wound from one roller to the other. The front of the frame is sheathed with armor plate having a square opening which leaves the paper exposed. A section of paper is run across this space for each shot in ordinary bull's eye firing, being wound up on the second roller after each round.

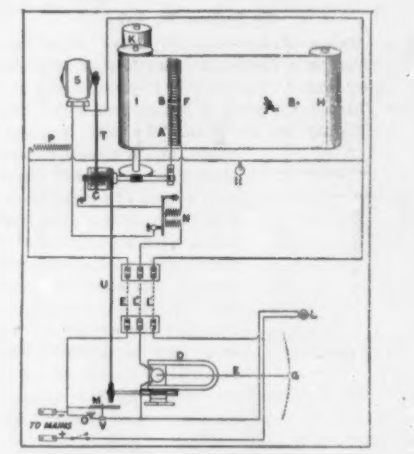
The hole B in the diagram is caused by the passage of the bullet through the paper. In the course of being wound up the paper passes under a row of contact fingers F, and the perforation permits one or more of the fingers to drop through, making contact. The electric circuit thus established immediately disconnects a clutch C, which stops the rollers, and the position of the bullet hole is instantly indicated on the reproducer located beside the marksman at the firing line. He can thus instantly ascertain the effect of his shot.

The reproducer is a transparent replica of the object target, having behind a permanent magnet milli-amperemeter D, the pointer of which, E, carries on its tip G a small white disk representing the bullet hole. When the reproducer is electrically energized from the object target, this small white tip comes to rest in a position exactly corresponding to that of the hole in the object target. Small electric motors serve to operate the rollers, and on short-range targets this movement is mechanically transmitted, on a reduced scale, to the carriage of the pointer in the indicator, the pointer moving horizontally across the face of the reproducer at a speed, and for a distance, corresponding to the movement of the paper perforated by the bullet across the face of the object target. This gives the horizontal position of the bullet hole on either side of the bull's eye. The vertical position of the bullet hole is determined by the vertical row of fingers F, as already explained. The fingers are set close together like the teeth of a comb, and when making a contact through the bullet hole, establish a circuit, through a small continuous resistance, which varies according to the position of the finger, as the apparatus is calibrated, each successive finger being connected to a higher resistance than the one immediately below. The result is that the pointer on the indicator is moved vertically, and reproduces the correct elevation of the bullet hole on the target relative to the bull's eye. This ingenious combination of horizontal mechanical and vertical electrical movements insures the possibility of giving two hundred position indications per square inch.

If a card is placed in front of the object target, and a transparent facsimile in a corresponding position in front of the reproducer, accurate indications of the hits are secured. In such cases the object target is stationary. This is the practice generally adopted; but if the object be printed on the paper of the target, the latter can be fired at while in motion, and the hit be faithfully shown on the reproducer. Lifelike conditions can be reproduced by depicting a scenic view across which the figure of a man or other object printed on the moving paper is caused to move, there being an aperture in the outer covering through which the moving object can be seen. On the indicator screen a facsimile of the man is provided, and the results of the shots fired at the moving target are indicated on the reproducer, as well as all "misses"—complete information as to his skill which the marksman has hitherto been unable to obtain.

The roll of paper is punched at regular intervals with gage marks, through which contact is made to bring the machine at rest and return the pointer of the reproducer to "zero."

In the diagram the pointer is in the gage hole, and the current is flowing from the + main through the lamp L, illuminating the reproducer, and the adjustable potentiometer M to earth, and in parallel with this, going to earth through the contact finger F, it passes through the reproducer D to the cutout N, which cuts off the current from the magnetic driving clutch C. If the short-circuiting key O be pressed, the current is cut off from the cutout, and the armature returning, establishes the clutch circuit,

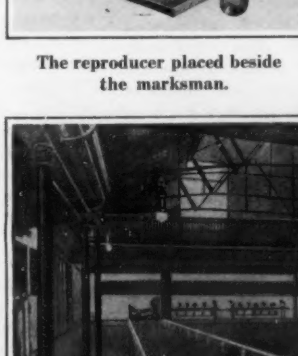


Arrangement of target apparatus and reproducer.

starting the mechanism and removing the perforation from the contact finger F, after which the key may be released, and if no shot has been fired, the machine runs until the next gage hole is reached, by which time the pointer of the indicator has traveled across the reproducer screen, released itself, and has returned automatically to zero. A shot is fired, the short-circuiting key is depressed momentarily, and the machine immediately starts up, the paper traveling until the bullet hole comes beneath the contact fingers. Another pressure of the short-circuiting key causes the paper to continue its travel until brought to a stop by the next gage hole.

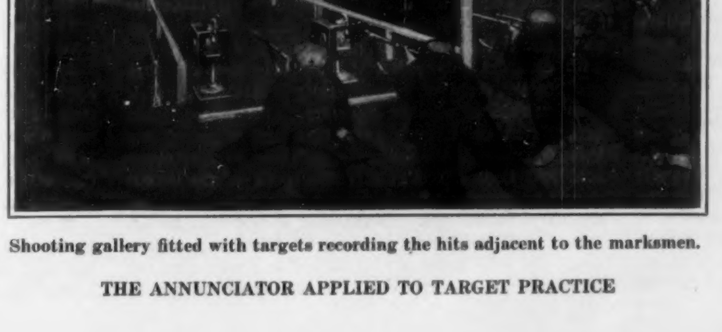
To start the apparatus, it is only necessary to insert a plug in a lamp socket and then to switch on. There is a shunt P across the clutch coil; R is the target illuminating lamp, S the motor driving the paper, H the reserve roll of the paper, I the speed roller from which the speed of the traveling paper and pointer of the reproducer are controlled, K the receiving roller for used paper, $E\,L'L''$ connecting wires, U a belt driving the reproducer mechanism, and V a sliding contact maker to adjust the voltage of the reproducer circuit. The target can be instantly changed from dummy bull's eye to motion working, since the card is carried on a rod, and can be turned down out of the way for moving target firing. The used paper can be retained as a permanent record, such as of shooting competitions, and in case of dispute the results of firing can be easily checked or investigated.

The applications of the system are possible through a very extensive field. In long-range use the horizontal movement of the pointer on the reproducer is electrical, and the expense of a marker would be saved. The apparatus is simple in design and operation, the liability of breakdown remote, and the operating cost, confined to current and paper, of a trifling character. Military experts who have seen the apparatus in practical use in England, have expressed complete satisfaction with the infallible accuracy it provides.



The reproducer placed beside the marksman.

Rear view of target, showing paper rolls.



Shooting gallery fitted with targets recording the hits adjacent to the marksmen.

THE ANNUNCIATOR APPLIED TO TARGET PRACTICE

Oil-Cement Concrete

AN important investigative work during last year was the development of an oil-cement concrete, and from results obtained the experiments indicate that it would be practical to use this material for floors, cellars, foundation walls, tanks, silos, manure pits, and similar construction, where strength, solidity, and waterproof qualities are required.

[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

Experiments on Light

By Sydney W. Ashe

ARC UNDER WATER.—An attractive experiment performed in a darkened room is that of making an arc under water. Two carbon electrodes are used, one a rod, the other a piece of flat carbon, which may rest in the bottom of the dish. The dish is filled with water, and a circuit formed consisting of a 120-volt direct-current source of supply, the carbon rod as positive electrode in series with an adjustable resistance, and the submerged flat carbon electrode connected to the negative source. Upon bringing the electrodes together and then separating them, an arc will be formed for an instant under the water. Care should be taken not to allow the arc to be formed too long, or it may break the glass receptacle.

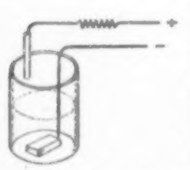


Fig. 1.—Arc under water.

PRINCIPLE OF THE OIL SWITCH.—If kerosene oil be substituted for water in the previous experiment, the arc will be quickly extinguished as soon as it tends to form. For this reason, this principle of the oil extinguishing the arc is used to advantage in modern oil switches used in central station operation. High-potential currents of several thousand kilowatts may be interrupted in a small compartment, due to the smothering action of the oil, which occurs when the alternating current is passing through zero. Where the same thing is attempted in air with an air switch, arcs sometimes 12 feet in length are formed when the air switch is opened.

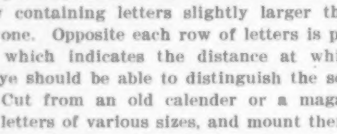


Fig. 2.—Experiment in visual acuity.

EFFECT OF A FOREIGN LIGHT IN THE FIELD OF VISION.—The effect of a foreign light in the field of vision on visual acuity may be readily shown by means of a home-made Mellen's chart. A Mellen's chart is one containing a large number of letters in different rows, each row containing letters slightly larger than the previous one. Opposite each row of letters is placed a number, which indicates the distance at which the normal eye should be able to distinguish the series of letters. Cut from an old calender or a magazine a series of letters of various sizes, and mount them upon a white card with an unglazed finish. Fasten the card to the wall in a darkened room, and place a candle on a table with the same height as the letters, so that it can be moved at various distances from the letters. This will vary the intensity of the illumination upon the letters, the intensity varying inversely as the square of the distance. When the candle is 1 foot from the letters, the illumination will be 1 foot candle; when it is 2 feet, the illumination will be $1/2^2$ or 1/4 of a foot candle. The candle-power divided by the distance squared gives the illuminating value. The candle should have a black card placed behind it, so that the light will be screened from the eye of the observer.

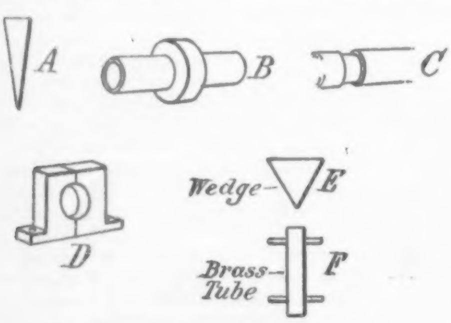


Fig. 3.—Elements of a flicker photometer.

To one side of the chart is placed another candle, unscreened, which may be used when occasion arises. With the standard candle placed at 1 foot from the chart in a darkened room, the observer should gradually approach the chart until he is able to just distinguish the letter. This final distance of the observer from the chart should be noted, and the experiment repeated about ten times, and the average distance from the screen noted. The observer should remain in the room about fifteen minutes before taking observations, so that the eye will have sufficient time to become accommodated. The foreign light to one side of the chart, about 1 foot's distance, placed so that it will not add additional illumination to the chart, should then be lighted, and the experiment repeated. It will be found that it is necessary for the observer to approach the chart much closer in order to be able to read the same letter with the standard candle placed at the same distance. The foreign light in the field of vision decreases the observer's ability to read about 35 per cent.

HOW TO BUILD A FLICKER PHOTOMETER.—During recent years, the flicker photometer has become recognized as the standard method of comparing lights differing in color. Such a photometer is quite easy to build. Procure from an oculist a 10-deg. glass prism, *A*, Fig. 3. This will cost from 30 to 60 cents. Mount this prism in the end of a ½-inch brass tube *B*, 2 inches long, and mount a small pulley on the tube. The tube should then be supported in two bearings *D*, so that it can be rotated. If a lathe is handy, a groove *C* may be let in the tube in two places, and mounted in two supports *D*, as in the illustrations. A small diaphragm containing a ⅛-inch hole should be mounted in the opposite end of the rotating tube. A plaster of Paris wedge *E* of 60 deg. should then be made, or it may be made from thin pieces of board. The point of this wedge may be mounted opposite one end of the brass tube—the end containing the 10-deg. prism. This whole apparatus may be mounted in a light-tight box containing two apertures, opposite which are placed the two lights to be compared. The observer places one eye in line with the rotating prism, so that he can look through the tube, and see first one side of the wedge and then the other as the prism turns. The observer's eyes may be shielded from foreign light by means of a hood *G* of leather, which is fastened to the photometer box. Two light screens *H* should be mounted opposite each of the circular openings in the box, so as to screen off any reflected light. The rotating tube may be driven by any form of motive power. If a small shunt motor is used, operating on a direct-current source of supply, the field may be connected directly to the source of supply, and the armature shunted from a series resistance, which is connected directly across the mains. This produces a variable speed of quite a large range. One of the lamps to be compared is a standard lamp, which is fixed at a given distance, say 100 centimeters, from the photometer box opposite one of the openings. The other lamp should be movable, and attached to a sliding stick. Opposite the center of the photometer box should be a spring contact point. Pressing this point down when a balance is made will punch a small hole in a paper fastened to the movable rod. Ten settings should be made, and the median point located. In locating the median point, count from either the right or the left, and mark an arrow between the fifth and the sixth point. Remove the thumb tacks, and then insert another piece of paper in position. To operate the photometer, see that the standard lamp and the lamp under test are operating upon a constant voltage of the required value. Place the standard lamp at a distance of 100 centimeters from the photometer zero, and start the motor operating, which will rotate the photometer observation tube. If the speed be very slow, and if the two lamps are illuminating the wedge with different intensities, the observer will see first one circular field of one intensity and then another circular field of another intensity. Where two lights of different color, such as a blue and a green, are being compared, the observer will see first a green field and then a red field. The speed of the motor should be increased until about seven flickers a second are perceivable. The movable rod should then be adjusted until the flicker disappears. When this adjustment has been made, a hole should be punched in the paper on the movable rod. If the motor switch be opened so that the tube may be rotated by turning the belt, it is possible to turn the tube so that both sides of the plaster of Paris wedge are visible at the same time. Adjustments may then be made, using the photometer as an equality of brightness photometer. If a wedge of wood is used, pieces of print may be mounted upon each side, and the movable bar adjusted until the type may be read with the same clearness on both sides. With these various arrangements of the photometer, it is possible to compare the three principal methods of comparing light intensities—the flicker method, the direct comparison method, and the acuity method. It will be interesting in this connection to note two things—first, that the median of the readings for each method will not coincide, and second, with the flicker method the individual readings will be closer together.

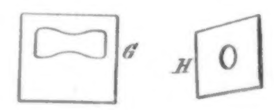


Fig. 4.—Hood and screen.

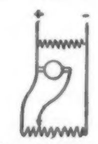


Fig. 5.—Motor connections.

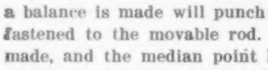


Fig. 6.—Arrangement of the photometer.

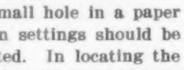


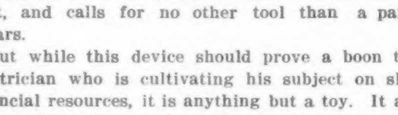
Fig. 7.—Record sheet.

A Simple and Adaptable Form of Electrical Contact

By W. P. White

IN ninety-nine cases out of a hundred, the most effective electrical contact is one where the pressure is given by a spring. In eighty-nine cases, perhaps, out of a hundred, the most convenient electrical contact also can be obtained by the use of a spring. The familiar binding post is an admirable device; it is simple, cheap, and compact; but it has disadvantages. For instance, as a rule, any one binding post will seldom hold all sizes of wire. Binding posts often tend to break or deform the wires which are clamped in them. And, worse than this, wires are apt to work loose from binding posts, so that considerable vigilance is often required to prevent errors from loose contacts. Another disadvantage is the loss of time where contacts have to be often changed or readjusted. If a device can be found which permits contacts to be made by a single motion, and at the same time has in other respects the main advantages of the binding post, the binding post would certainly be inferior in comparison.

Such a contact is possible; it is free from all the above disadvantages, and is actually cheaper than the binding post. It can easily be made of a strip or tongue of thin sheet copper (or brass) inserted into one of the common wooden spring clothespins, as in the accompanying engraving. The resulting "clamp contact" will take hold or let go instantly, and yet, if desired, it will hold indefinitely without danger of imperfect contact. It will hold anything, fine or coarse, round, flat, or irregular, that is not too big to enter its jaws. It costs less than half a cent, and calls for no other tool than a pair of shears.



An efficient contact clip.

But while this device should prove a boon to the electrician who is cultivating his subject on slender financial resources, it is anything but a toy. It allows both contact pieces to be made of soft copper, so that, if copper wires are employed, as usual, no different metal is introduced into the circuit by the contact. This favors freedom from thermo-electric electromotive forces; moreover, such freedom is also favored by having the contact made between thin strips of metal, which quickly come to a common temperature. As a result, this form of connector is rapidly coming into use in the most delicate and refined measurements.

The resistance of such a contact is surprisingly low (0.0002 ohm when clean, or about the same as in the best dial switches); of course, some attention must be given to cleanliness, but no more than with most other types of contact.

If two copper strips, separated by a wider strip of celluloid, are shoved into the same clamp, a two-pole contact is obtained. This can be quickly clamped on a two-pole contact point made of two other similar copper strips similarly separated by sheet celluloid. If the leads are not too stiff and short, the whole can easily be used as a commutator, without any further alteration. Connections are reversed by simply turning the clamp through 180 deg.

An even quicker commutator can be secured by a slight change in the contact point, which now consists of two U-shaped pieces of sheet copper. These pass through the celluloid, so that the strip which is in front of the celluloid at one end is behind it at the other, and conversely; the commutation then requires merely sliding the clamp along.

If two clamps are fastened together, side by side, as by screwing them to a short strip of wood, they can both be opened by a single motion.

The above suggestions suppose a flexible connec-

tion to the clamp. This can be avoided (for instance) in a single contact by arranging to clamp a single, bent copper strip so as to join two stationary strips, which are insulated from each other by celluloid.

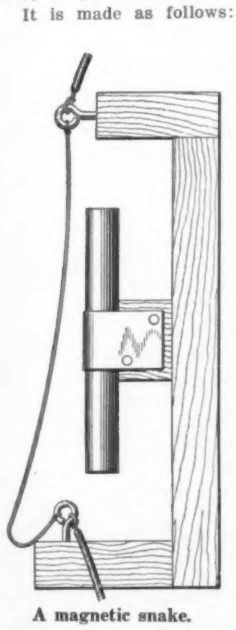
The clothespin contact has been used to give a simple arrangement for inserting one ammeter successively into several different circuits without interrupting current. At the point where the insertion is to be made, two copper strips run down into the clamp, insulated from each other by celluloid except at the end, where they are usually in contact, closing the circuit. The ammeter leads terminate in two copper strips, which run on the opposite sides of a wooden wedge. When this wedge is forced into the jaws of any one of the clamps, the original contact there is broken, but not till after the ammeter is connected to both sides of the break, so that the current is not interrupted.

A Magnetic Snake

By Chancy W. Nieman

A VERY interesting and beautiful experiment for the home laboratory, and one which shows in a very striking way the relation between electricity and magnetism, is the magnetic snake. All the preparation necessary for this experiment is a bar magnet, a few batteries of any form, and a small amount of very simple construction.

It is made as follows: A few strands of tinsel, such as is so much in evidence at Christmas time, are braided together to a very flexible electric conductor, as shown clearly in the accompanying illustration. The ends are attached to two screw eyes, which are screwed into the wooden support. A bar magnet is fixed by its middle as shown. Wires from a few dry cells are connected to the two screw eyes. It is best to have a reversing switch, so that the direction of the current through the tinsel can be changed. When the current is turned on, the "snake" will act like a live boa constrictor, coiling itself with great suddenness and velocity around the unsuspecting bar magnet. Upon reversing the current it will quickly uncoil itself, and writhe around until it is tightly wrapped up in the opposite direction. If the magnet is not painted about the middle, a layer of paper should be put around it to keep it from short-circuiting the tinsel.



A magnetic snake.

The direction in which the snake wraps itself is the same as that in which a piece of wire would have to be wrapped to make an electro-magnet with the poles at the same ends as the poles of the bar magnet.

How to Make an Insulated Thumbscrew

TAKE a small pill-box, the size of the required head. Fill it with hot sealing wax (black preferred), then while still soft, place the head of the bolt or screw in it, and allow it to cool. A piece of bent tin may first be soldered to the head of the bolt to give the wax a good grip. When cool, the paper box may be washed off and the wax touched up with a hot knife blade. Milling may be put around the edge in the same way.

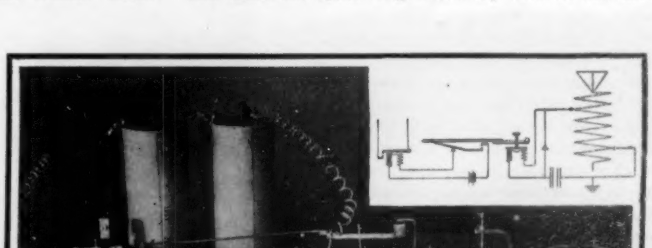
A Sensitive Relay for Wireless Telegraphy

By E. H. Williamson, Jr.

IT is probable that the majority of amateur wireless telegraphers are in the habit of sitting by their receiving apparatus with the telephone receivers over their ears waiting for the buzz which indicates that "something" is coming in from the aerial. It is also probable that many of them have gotten very tired of sitting there listening for long periods and have removed the silent 'phones just as a message has started to come in. Being in this class myself, I started experimenting to see if there was not some method by which the incoming Hertzian wave would either register itself, or at least give a signal which would be audible without the necessity of keeping the 'phones to the ears. Several devices were tried without success, and finally the one described in this article was built, which gave a reasonable degree of satisfaction when carefully adjusted.

The principle involved was very simple, namely, to increase the minute motion of the telephone receiver diaphragm by a system of levers, so that a local circuit could be closed and broken simultaneously with the movement of the diaphragm.

The relay was made as follows: A hard wood base, eight inches long by three inches wide, was made, these dimensions being convenient but not necessarily to be adhered to. Across the ends two strips were screwed to raise it one-fourth of an inch. An ordinary "watch case" double pole telephone receiver was wound to about 250 ohms resistance with No. 38 S.S.C. copper wire. This was set at the right-hand side of the base one inch from the end, the ring projecting from the receiver being clamped between two strips of wood through which a screw was driven into the base, holding the receiver immovable. A strip of one-sixteenth of an inch brass one-half of an inch wide and three and one-half inches long was bent over for one inch, at right angles and a U-shaped strip of thinner brass soldered to the bent arm so as to project downward. A notch was then filed centrally at the bottom of each leg of the U, and the standard was screwed vertically at the end of the base board. The photograph shows the idea clearly. A lever arm was made from a piece of three-sixteenths of an inch square brass bar three inches long, a long thin brass pin being soldered across one end, so as to rest in the notches of the U, to form a pivot for the lever. This bar was drilled and tapped for a 4-32 machine screw at a point one and one-half inches from the pivot, so that the screw would be over the center of the diaphragm. A one-inch machine screw was then driven through the square bar until it rested on the diaphragm, and held the lever parallel with the base. A piece of No. 1 copper wire eight inches long was then soldered to the left-hand end of the bar, making the total length eleven inches. The motion of the diaphragm was of course multiplied at the end of this lever, but not sufficiently, nor steadily enough to depend on for a make and break of contacts, so a second lever, also of copper wire, No. 41, six inches long, was pivoted on a U-shaped support, of brass, screwed to the base. The left end of this lever was bent at right angles and so adjusted as to rest with a slight weight against the lower surface of the first lever, the cross arm pivot being set two-thirds of the way toward the left end for this purpose, and also to multiply the movement further. At the right end of the second lever, a short brass strip was soldered, provided with a machine screw and washer under which was clamped a piece of No. 22 platinum wire pointing upward. A brass block with a similar strip and screw projecting from the left side was screwed to the base in such a manner that the left side could be raised and lowered a trifle. A bit of platinum foil was clamped to this support by the screw and washer and the right end of the second lever bent up until the platinum wire was about one-sixteenth of an inch below the foil. This distance was again reduced by unscrewing the machine screw in the bar about one turn, thus dropping the first lever and raising the opposite end of the second. The final adjustment was made by lowering one side of the contact block until the two contacts were almost touching. The terminals of the telephone receiver were connected with two binding posts at the right. The posts at the left connected the contact block and the U support of the second lever. The receiver was put in circuit with a home-made silicon detector, shown at the right, the aerial and ground wires being connected as usual. From the relay posts a local circuit was run to a battery and home-made telegraph relay of 200 ohms resistance. When the armature of this relay was finely adjusted close to the magnets, it would vibrate with a sound quite audible in any part of the room when the telephone receiver diaphragm moved under the influence of a wave from the aerial.



A sensitive relay for wireless telegraphy.

I tried connecting a single stroke electric bell to the terminals of the second relay and got a sound out of it, but it was no better than that of the relay alone, so I abandoned this plan.

The first contacts in the relay were made with mercury and platinum, but did not work, as the capillary attraction of the mercury prevented a break when a contact was once made. The wiring chart gives a clear idea of the various circuits and their connections.

Concrete Cathedral

THE cathedral of Poti on the Black Sea in Russia is built entirely of reinforced concrete. It is of the Byzantine type, designed somewhat after the St. Sophia structure of Constantinople. As the loose sandy soil near the Rion River, upon which the building is located, will admit of but little weight on the pile foundation, reinforced concrete answered the purpose very well, and it took less than a year to build, against ten years for the Batoum and other Russian cathedrals, besides costing much less. It has a main dome surrounded by half-domes covered with sheet iron. A pressure of but twenty pounds per square inch was permitted upon the foundations.

Colored Shadows

By Prof. Gustave Michaud, Costa Rica State College

NOT many people are ready to admit that a dead black, opaque, object may cast, in special circumstances, a beautifully colored shadow upon a white surface, yet the fact can be shown in less than five minutes wherever two candles, a sheet of black pasteboard, and two pieces of colored glass (red and green) are at hand.

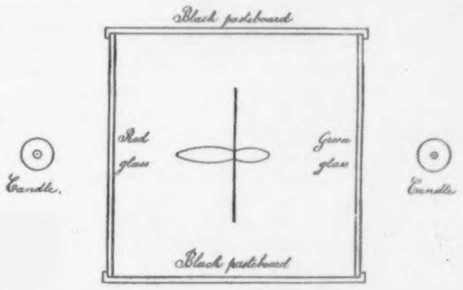


Fig. 1.—Plan view of box for producing colored shadows.

Fig. 2.—Front view of butterfly frame.

With these implements a parallelopipedic box is erected upon a sheet of white paper, the top of the box being left open. Fig. 1 is a top view of box showing the arrangement of the four pieces of glass and pasteboard.

A piece of black paper is then cut to about the shape shown on Fig. 2, and glued across a small piece of pasteboard. Fig. 2 is a front view of the whole. A top view is seen in the center of Fig. 1. The candles are placed as shown in Fig. 1, and every light but two candles being extinguished, it becomes evident that the paper bottom of the box remains as white as before in spite of the fact that colored light only now falls upon it. The vertical piece of black paper is now laid on the center of the box in the position in Fig. 1.

The result is a beautiful butterfly which appears on the white paper. Its posterior pair of wings is intensely red; the anterior pair is of a pure green color. White disks are seen on the corner of each wing.

These wings are but the shadows of the vertical piece of black paper, deposited in the middle of the box, and the reason why an opaque object may, in such circumstances, cast a colored shadow on a white surface lies in the fact that red and green lights are complementary and give white light wherever they fall together. On the other hand, wherever the opaque object intercepts the green light only, the paper remains red, and, similarly, wherever a shadow is cast for the red light only, the paper will be green.

If, instead of being placed so as to cast a shadow for one color only, the black paper intercepted both of them together, the result would of course be the ordinary dark and colorless shadow.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

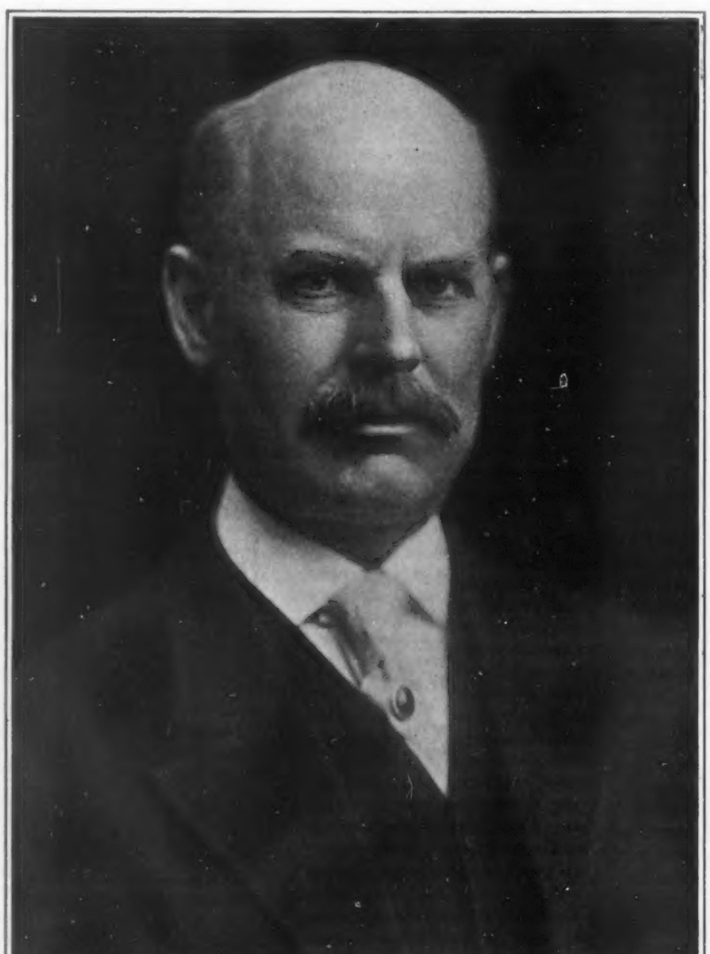
My Days With Edison

By Edward G. Acheson

IN the autumn of 1880 I decided to cast my lot in the East. Edison and his laboratory at Menlo Park were then much in the public eye. I had little hope of securing an opening there, but as a desperate, final resort, took the train out to Menlo Park. I climbed the low hill from the station and entered a small brick building in the corner of a large fenced inclosure. The building contained the office down stairs and Edison's library up stairs. I handed my card to a boy in the office with the request to see Mr. Edison. He took the card and disappeared; presently returning, he opened a small wicket gate, and inviting me to enter, conducted me out of a rear entrance of the office, across a vacant lot, and into a long two-story frame building. He took me up stairs and into a room covering the entire second floor containing a number of long pine tables, the walls being lined with shelves holding bottles. At one of the tables sat three men; the center one in a colored calico shirt, without coat, was introduced as Mr. Edison. The one on his left I knew afterward to be Mr. William J. Hammer, and the one on the right as Mr. Francis R. Upton. Mr. Edison, placing one hand to his ear to indicate I should speak loudly, asked, "What do you wish?" I replied, "Work." He replied, with perhaps impatience, "Go out to the machine shop and see Krussi," and returned to the work absorbing his attention. Mr. Hammer kindly told me to go down stairs, pass back through the laboratory, cross the yard to a one-story brick building, and inquire for Mr. Krussi, who was the superintendent.

I followed Mr. Hammer's directions, and entering the machine shop, found myself in a small office, almost completely filled with a large draughting table, over which a man was working. An attendant received my inquiry for Mr. Krussi, and while he was gone I was very busy preparing myself, loading my gun, so to speak. The draughting table inspired me. I had had some experience using the tools of a draughtsman in my civil engineering work. Presently a tall, foreign-looking gentleman entered and asked me what I wanted. This was Mr. Krussi. On the spur of the moment I am afraid I told a white lie. I replied, "Mr. Edison sent me to you for you to put me to work." "What kind of work?" he asked. "Draughting," I said. "All right," he replied. "Mr. Hornig needs an assistant. Can you report for duty Monday morning?" I assured him I could. So it happened that the 12th day of September, 1880, while still in my twenty-fifth year, saw me installed in Mr. Edison's employ at Menlo Park, N. J. Mr. Krussi soon learned of the deception I had played upon him, and held me under suspicion for a long time.

Menlo Park, in the fall of 1880, was composed almost entirely of Edison's interests. There was the Pennsylvania Railroad station, a hotel, at which I boarded, the homes of Mr. Edison, Charles Batchelor, and Francis Upton, three or four boarding houses, Edison's laboratory, office, machine shop, and a new building to be used as a lamp factory, the first of its kind ever constructed. There were probably two hundred men employed in the Edison works and great activity existed. A few days after I was at work, I took up the subject of perfecting a small dynamo I had made long ago. I found it so faulty that I concluded to build a new one. I had the necessary iron castings made at Newark, and with the help of a coworker, Martin Force, to set the tools in the lathe, I worked in the machine shop at night, where I was permitted the use of the tools. Mr. Edison several times stopped at the lathe at which I was working and watched me intently. I presume he had forgotten me and had to inquire who I was. Edison was then but thirty-three years of age, although world-renowned by reason of his great telegraph inventions. The world was at that time looking expectantly to Menlo Park for the solution of practical electric incandescent lighting. After I had been at Menlo Park long enough to feel at home, I showed Edison the small dynamo I had made at Bradford and asked his opinion of the ideas involved. He said it was like the one designed by Siemens, and told me to go over to his library and get from Dr. Moses, the librarian, a certain book in which I would find a machine like mine described. I did so and found, as he had said, Siemens's dynamo almost exactly the same as the one I was working on. I remember the book contained a photograph of the machine, and it was a fair picture of my own machine, design of the frame and all. I then changed the design to that of a rotating transformer.



EDWARD G. ACHESON

Shortly after this personal acquaintance was formed with Mr. Edison, I was transferred from the position of assistant to Mr. Hornig to the draughting-room devoted to making the drawings for Mr. Edison's patent applications and more special work in which Mr. Samuel D. Mott was principal daughtsman.

Mr. Edison was at this time working upon an electric meter to be used in connection with central station distribution. I became acquainted with the requirements of the case and the urgent need of such an instrument. What appeared to be a happy thought occurred to me for the method and design of a meter. I made a drawing of my proposed instrument, and the next time Edison came into the room I showed it to him. He seated himself on a high stool at the drawing table, put his arms on the board and his head, face down, on them, and seemed lost for some time in thought. After some minutes he raised his head and addressing me said, "I do not pay you to make suggestions to me. How do you know but that I already had that idea, and now if I use it you will think I took it from you." I assured him that I considered anything I could produce while in his employ and pertaining to his interests, belonged to him; that my thinking on those lines was due to my being in his laboratory and cognizant of his needs and lines of work. He made a test of my meter scheme, and notwithstanding it looked so feasible, it proved a failure. Immediately after this incident, I was taken from the draughting-room and placed in the original experimental department. I was now in my glory. I had a large room under my supervision, equipped with all the conveniences required, balance room, muffle furnaces, air pressures, gas, electricity, steam bath cabinet, etc. I was thrown into association with most agreeable companions. I, at this time, formed a close friendship with Dr. Edward L. Nichols, who had recently returned from Europe, where he had followed an extensive course of study in the foremost universities of the Continent. He was at this time doing special scientific work for Edison. The doctor is now Professor of Physics at Cornell University. I made a number of special investigations for Edison—especially on the filament for the incandescent lamp. I had every opportunity to use my inventive faculties.

I think it was in the following December that I was one day called by telephone to go down to the new lamp factory and see Mr. Edison. When I arrived at the factory I found Mr. Edison, Francis R. Upton, Charles Batchelor, and Edward H. Johnson in conference; these three gentlemen were partners of Edison and looked after various departments. I was ushered into their presence, and Edison informed me that Mr. Batchelor, who was in charge of the construction department, and operation of the lamp factory, was soon to sail for Europe to prepare for the exhibit to be made at the electrical exposition to be held in Paris during the coming summer, and that he wished me to take charge of the factory. I demurred, and said I would much prefer to remain in the laboratory on experimental work. He said that lamp manufacturing was still experimental, and he was kind and frank enough to say he wanted me to take hold of it because I was a thinker. He won the day, and under Mr. Batchelor's instruction I began my duties. I think it was the third or fourth day after I had been there that the following conversation occurred between Batchelor and myself: "Mr. Batchelor, how much am I to get here as salary?" I asked. "How much have you been getting at the laboratory?" he answered. "I was getting seven dollars and fifty cents per week." "Well, I think we can do a little better here," he said. "You will have to pay me one hundred dollars per month if you wish me to remain. I was getting seventy-five dollars, and could have had ninety dollars per month from the Standard Oil interests, but I threw that aside to enter experimental work," I replied. "That is more than we can afford to pay," he said. I told him I was of the same opinion, owing to my inexperience, but he would have to excuse me from continuing. I did not return the next day. Mr. Upton, against his will, was required to take charge and relieve Mr. Batchelor.

I sat around my boarding house for several days, and spent most of the time wondering if I had made a mistake. Finally I brought my courage up to the point of walking up to the laboratory. When I entered I met Edison, and he laughingly joked me about not being able to stand the work of the lamp factory. Then he said: "There in the end of the room is a hydraulic press; have it put in order, and make for me a small graphite loop like this (making a sketch like a horseshoe). I want the loop one inch outside diameter, the filament to be twenty-five thousandths of an inch wide and two thousandths of an inch thick. I will have steel plates made

for you to press sheets between, and a die made for punching out the filaments. When you make one capable of mounting in a lamp, I will give you a prize of one hundred dollars." All of which was done as he wished, and I received the one hundred dollars. I find I now have in my safe an ordinary visiting card on which is pasted one of these graphite loops, and on the card is written:

"MENLO PARK, N. J., Feb. 11th, 1881.

"Hydraulic pressure one hundred tons. (This referred to total pressure on a sheet of graphite about one and three-quarter inches by four inches from which the loops were punched.) Thickness, fifteen ten-thousandths of an inch. This loop won one hundred dollars as a prize; the prize being offered by T. A. Edison to the undersigned.

"E. G. ACHESON."

Mr. Edison then entered into an agreement with me to make thirty thousand of these filaments. I engaged a man and a boy to help me, and became so expert at making them that I was earning twelve dollars per day by the time sixteen thousand had been turned out. Edison at this time was occupied in New York, building the first electric lighting station in Pearl Street. The filaments I was making of graphite produced a magnificent light, but they did not last long in use, disintegrating rapidly. I had made sixteen thousand of them and then went to Mr. Upton and told him that I was not happy in making an inefficient article, notwithstanding it was yielding me a great deal of money. I considered it a waste of money and would much prefer to throw up my contract. He wrote to Mr. Edison about the matter, and in a few days I received the following letter:

"NEW YORK, April 20th, 1881.

"Mr. E. G. Acheson,
"Menlo Park, N. J.

"Dear Sir:

"You had better go into the lamp factory and learn the lamp business in all its details. Yours truly,

"THOS. A. EDISON."

I at once knew this meant my preparation for a sojourn in Europe as expert in electric lamp manufacturing. I now returned to the lamp factory, which I had a few weeks before left, but under very different auspices. I went through all of the departments, learning to do the work with my own hands. The filaments were then made of bamboo. I fashioned the wood fiber, carbonized them, mounted them on their platinum wires, which I had sealed in glass, for the base of the lamp, called "inside part." I sealed the "inside part" into the glass globe, exhausted the air from the lamp, sealed and tested it and prepared it for shipment. I studied the details of the various machinery and apparatus of the factory, and made myself competent to construct and operate one. My relations with Edison at this time may be gathered from the following letter:

"MENLO PARK, N. J., May 2nd, 1881.

"Mr. E. G. Acheson:

"Please come up to the laboratory and bring one of those nickel molds in which they bend the fiber to carbonize it, and press a piece of plumbago the thickness of the mold. It is, I believe, one-eighth of an inch, and then hollow it out for the nickel piece to allow the carbon to draw up. After you have got it, have Dr. Haid pass the gas over it. I want to see if we cannot make these little plated molds out of plumbago, using the nickel piece to put straight on the fiber. If we could use these, it would save a great deal of money. Also try some experiments on getting the best mixture of litharge and glycerine, also the right proportions of plaster of Paris for the sockets of the lamps.

"We are lame on these points. Yours,

"EDISON."

While I was thus preparing myself for the specific work of electric incandescent lamp manufacturing, I was at night diligently at work studying electrical distribution, measurement, and the science generally. At this time the literature devoted to electrical science was limited. I have here before me a book to which I owe much; it is certainly dry reading, but I worked hard over its contents. It is entitled "Reports of the Committee on Electrical Standards, appointed by the British Association for the Advancement of Science," published under date of 1873.

After I had fairly well mastered the lamp business, Edison had me prepare a complete set of instruments for measuring the efficiency of lamps. These consisted of a rheostat, condenser, galvanometer, standard cell, resistance coils, Wheatstone's bridge, and photometer. This last-mentioned instrument was the only one built under my supervision and according to my design. A description of this photometer is given in the volume "Dynamo-Electricity," by George B. Prescott, 1884.

The Dedication of the Diamond Match Patent to the Public

ON January 28th, 1911, there was recorded in the United States Patent Office a remarkable instrument. This was the formal, legal relinquishment by the Diamond Match Company of its rights under Letters Patent No. 614,350, granted November 15th, 1898, to Henri Sevene and Emile David Cahen, of Paris, France, for an "Improvement in Match Compositions."

This action by the Diamond Match Company was the outcome of a series of events which were of international importance. The deleterious effects of the use of white phosphorus in the manufacture of matches has long been the subject of serious investigation, with the result that in European countries the use of this poisonous substance, except in combination with counteracting agents, is regulated by law. It is well known that white phosphorus causes necrosis of the jawbone and teeth, and the principal sufferers therefrom have been those employed in the manufacture of the common parlor match.

The Bureau of Labor at Washington, Charles P. Neill, Director, has conducted a series of experiments, covering an investigation of match factories in the United States, and the conclusions reached were so overwhelmingly against the existing process of match manufacture, through the use of white phosphorus that it led to a recommendation by the President in a message to Congress, looking to the attaching of a heavy tax on those factories using the phosphorus in this form.

The result of such legislation would, of course, compel the manufacturers to devise a suitable substitute for white phosphorus, with the possibility of being charged high royalties for the use of processes already controlled. The suggestion for legislation was looked upon with disfavor among some members of Congress, who considered it an abuse of the tax privilege, and also saw in its operation the possible building up of a huge monopoly on the part of those who controlled patented processes of substitutes for white phosphorus.

The Sevene-Cahen patent covered a non-poisonous sesqui-sulphide of phosphorus, one of the few known adequate substitutes for white phosphorus. The Diamond Match Company was the sole owner of this patent, and the company was thus in a position, if prohibitive legislation were enacted against white phosphorus, of controlling the match output of the country, or else of being able to collect large royalties for the use of the Sevene-Cahen process.

Rather than be placed in the position of being a beneficiary under legislation that was needed for humanitarian reasons, the Diamond Match Company has abandoned its right to the sesqui-sulphide process and has dedicated the invention described in the patent to the people of the United States forever. The instrument abandoning its rights to the Sevene-Cahen patent was accordingly prepared, and was recorded in the Patent Office, Commissioner of Labor Neill, Edwin R. A. Seligman and Jackson H. Ralston acting as trustees. The relinquishment is also signed by Edward R. Stittinius, president of the Diamond Match Company.

The effect that this will have on the match industry of the United States is far-reaching. It will enable every match manufacturer in the country to operate without endangering the health of his employees or putting upon the market a substance well known to be poisonous and disease-spreading.

The Sevene-Cahen substitute for white phosphorus, while being harmless to the health of the workmen, possesses a definite chemical composition and is easily inflammable. This sesqui-sulphide of phosphorus is obtained in a state of purity by distillation. The formula described in the patent is as follows: Sesqui sulphide of phosphorus, 90 grams; chlorate of potash, 800 grams; peroxide of iron, 110 grams; zinc-white, 770 grams; powdered glass, 140 grams; glue, 100 grams; water, 290 grams. The advantage of this formula as claimed over the various preparations of mixed pastes for matches, such as a mixture of amorphous phosphorus and sulphur either in powder or the state of fusion, is due to the fact that the sesqui-sulphide of phosphorus is very stable, resists moisture, and can easily be utilized and manipulated industrially.

It is not known whether the action of the Diamond Match Company in thus freely giving to the people of the United States the use of this valuable formula will have the effect of rendering unnecessary the proposed legislation against the use of white phosphorus, but as the Sevene-Cahen process has been used with great success by the Diamond Match Company and it is the only non-deleterious substitute that is commercially practical, there appears to be no good reason why the other manufacturers of matches in the United States shall not now use the harmless process, thus doing away altogether with the use of white phosphorus.

The legality of the document signed by the Trustees and the Diamond Match Company will hardly be questioned. While the patent has about five years to run, it is assumed that the contract between the Diamond Match Company and the inventors has been fulfilled, or will continue to be fulfilled. Since the inventors are not recited in the instrument lately recorded in the Patent Office as being parties at interest, it can be reasonably deduced that their claims under the patent have already been satisfied.

There is apparently no "string" tied to this free will offering to the American public, and the Diamond Match Company by this act places itself in the position of a public benefactor. In these days of monopolies and trusts it is an unusual spectacle to find a large corporation relinquishing for the benefit of the public interests which if taken advantage of can be made to yield hundreds of thousands of dollars.

The Death of Frederick G. Hesse

MR. FREDERICK G. HESSE, a distinguished inventor and engineer, identified for the last twenty-nine years of his life with the department of mechanical engineering of the University of California, died on January 27th, 1911, at Oakland, California, at the age of eighty-six years.

His career was full of action and interest. He received his education in Germany, and, after serving in the Prussian army, took part in the 1848 uprisings. Like many other revolutionists, he was compelled to seek refuge in this country. Here he became actively engaged in engineering projects. After lecturing at Brown University on engineering, he was topographical engineer in Pennsylvania and constructing engineer for many well-known railroads, after which he went to San Francisco to practise engineering. It was here that he became interested in inventions. Perhaps his best known invention is the centrifugal pump with which his name is identified.

The Report of the Commissioner of Patents

THE Commissioner in his annual report takes up first of all the subject of the examining corps of the Patent Office. As the result of an augmented force and increased salaries, the general standard of the work has been raised, the searches have been more thorough and more careful. The office is now in a better position to attract and retain men of special technical training and of university education.

The trade-mark division is commented upon with less optimism. Application has been made to Congress to provide a force of assistant examiners in trade marks and designs. When these are furnished, it is expected that the work of the division will be placed on the same level of excellence as that of the regular examining corps. The Commissioner urges the necessity of a new trade-mark law, which should be passed after the forthcoming Congress of the Union for the Protection of Industrial Property. This congress is to assemble at Washington in May of this year.

Great benefits are looked for from the work of classification of patents, which is at the present time about half completed. The Commissioner recommends doubling the force engaged on this work, as the saving of time which is gained through having at command properly classified material would far outweigh the additional outlay.

It is urged once again that one of the appeals should be eliminated from the present practice of the Patent Office. It is suggested that three members of the present Board of Examiners in Chief, together with the Commissioner, First Assistant Commissioner, and the Assistant Commissioner, should be formed into one appellate court, to whom appeal should be made directly. This would result in a great saving of time and money to inventors. A bill making these changes has been passed by the Senate and has the approval of the Secretary of the Interior, and it is hoped that the measure will be enacted into statute as soon as practicable. It also has the approval of the President of the United States, who is much interested in lessening the expense of litigation and simplifying court proceedings.

Among the changes which have occurred during the past year is to be recorded the repeal of the caveat law. Our readers are familiar with the circumstances of this matter. The only course open to an inventor now is to file an application for a patent.

Another very gratifying change in patent statute is the law enacted during the past session of Congress, whereby an instrument is placed in the hands of inventors, to enforce payment to them of proper compensation for the use by the government of their inventions. It is pointed out that in the absence of such protection a certain class of inventions, which owing to their nature can find purchasers only in national governments, were seriously discouraged, or worse still, the inventor was driven to sell his production to foreign nations.

Several treaties have been entered into with foreign countries, and the laws of several countries have been changed as regards the so-called working clause. A notable case is the treaty with Germany, which has been successfully negotiated. In its broad workings this treaty has the effect of not only protecting the American inventor, but the German inventor as well. The treaty has been construed by the Imperial Court sitting at Leipsic, and its provisions were upheld in some patents which had been declared forfeited, and they were ordered restored by the German Patent Office. Treaties of like import are now pending with other countries.

The Fourth International Conference

of American States, which convened at Buenos Aires, Argentine, in the summer of 1910, passed upon three conventions relating to patents, trade marks, and copyrights prepared by the Commissioner. These conventions are awaiting ratification by the respective governments represented, and their final adoption will result in great benefit to all the nations belonging to the Pan-American Union. One of the provisions of the trade-mark convention protects the Red Cross and Geneva Cross from improper use.

Those possessing trade-mark rights in the Red Cross prior to the passage of the law may however continue to use it still.

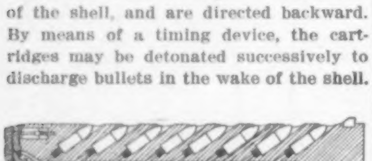
All the nations of the world, both those who are adherents to the Paris treaty of 1883, and all others, have been invited by the United States to hold the next Congress of the Union in the city of Washington, beginning May 15th, 1911.

The President of the United States has, through the Secretary of State, appointed as delegates to represent the United States at this congress, the Commissioner of Patents, Hon. Edward B. Moore, chairman of the delegation; Hon. Charles H. Duell, former Commissioner of Patents and ex-Justice of the Court of Appeals of the District of Columbia; Frederick B. Fish of Boston, Melville Church of Washington, D. C., and Robert H. Parkinson of Chicago, all of whom are leaders of the patent bar and well-known authorities in patent law and practice.

The efforts of the American Bar Association to establish a court of patent appeals are strongly indorsed by the Commissioner, who, at the request of the Committee on the Judiciary of the State, recently advocated the speedy passage of the bill creating this court. The patent profession is practically unanimous in its support of this movement. The Commissioner concludes his report with an appeal for additional working space for the Patent Office. He points out that the present building is entirely inadequate, even for the present conditions, and is rapidly becoming more and more so with the ever-increasing business transacted by the Office. He draws attention to the net surplus shown in favor of the Patent Office since the time of its origination to the present, a sum of $6,998,227, which he urges should by right be spent in furnishing the accommodation required for properly serving the interests of that class of the community from whom the receipts of the Patent Office are derived.

Patent Oddities

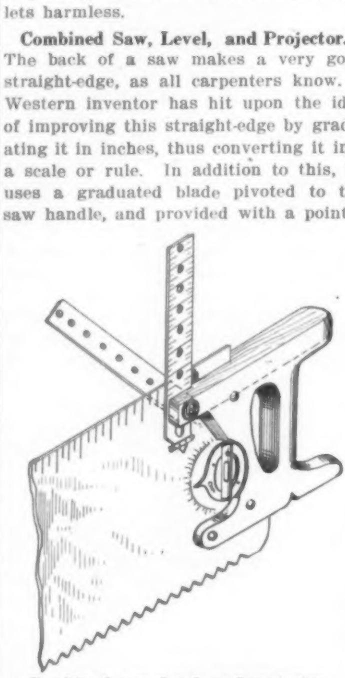
Curious Shell for Artillery.—Seeking to provide a means for attacking an enemy concealed behind an intrenchment, a German inventor has devised a peculiar form of shell, which in reality is an aerial automatic magazine gun. The center of the shell is filled with explosive materials and shrapnel shot, which is intended to be exploded as in an ordinary shell at a predetermined moment. In addition to this, there are four partitions, in each of which there is a series of holes adapted to receive rifle cartridges. These holes form an acute angle with the axis of the shell, and are directed backward. By means of a timing device, the cartridges may be detonated successively to discharge bullets in the wake of the shell.



Curious shell for artillery.

The idea is to regulate the speed of the bullets, so that they will strike backward, despite the forward motion of the shell, and attack the enemy behind the trenches. Of course, in such a system, the majority of the bullets would be wasted, as only those that were directed downward at the moment of discharge would strike the enemy with sufficient energy to do any damage. Furthermore, the position of the shell, unless it were given a very flat trajectory, would make even these bullets harmless.

Combined Saw, Level, and Projector.—The back of a saw makes a very good straight-edge, as all carpenters know. A Western inventor has hit upon the idea of improving this straight-edge by graduating it in inches, thus converting it into a scale or rule. In addition to this, he uses a graduated blade pivoted to the saw handle, and provided with a pointer



Combined saw, level, and projector.

that swings over a graduated arc to show the position of the pivoted blade with respect to the straight-edge. This projector, if set at right angles to the saw blade, gives him a square. Still another attachment for the saw consists of a spirit level mounted in a swiveling table, with a pointer and graduated arc that indicates the position of the level with respect to the straight-edge.

Safety Gas Valve.—Considerable attention has been paid by inventors to the question of turning off the gas when the flame at the burner has been extinguished by a draught or in any other accidental way. The sectional view here published shows a recent invention seeking to accomplish this result by using the expansion and contraction of mercury. Sur-

Safety gas valve.

rounding the gas jet is a reservoir filled with mercury, containing at one side a cylinder in which a piston is fitted. This piston is connected to the valve. When lighting the gas, the heat of the match expands the mercury, forcing the piston outward. But should the gas be extinguished, the mercury would contract and would draw the piston into the cylinder, thereby closing the gas valve.

The Air Mattress in Olden Time

As we at the present time enjoy the luxury of an air or pneumatic mattress, we are apt to regard them as modern improvements. It is, however, a long hark back to the original blown-up bed. They were certainly known and used as early as the sixteenth century. An old cut accompanying an early translation of Vegetius A. D. 1511 shows armed soldiers reclining on an inflated mattress, a bellows being connected with one corner for convenience in blowing it up. The sleeping soldiers look as if they had entirely forgotten "war's alarms."

Legal Notes

Proposed Limited Patent Protection.—Among the novel suggestions for changes in the existing Patent Laws is one which would contemplate a more limited period for certain patents to run. It is contended that many patents are now allowed on articles which the patentees are not in a position to use themselves, and which they are unwilling to dispose of to manufacturers and others, except at exorbitant prices, thus tying up for seventeen years devices and improvements of various descriptions which, if procurable at reasonable terms, would be of use to the trade. The contention is almost made that there are many devices patented which show invention and are legitimately patentable, but which in reality have no commercial value. It is suggested that a varying scale of protection be established permitting the Patent Office, in its discretion, to apply to certain patents only a limited term of protection, thus hastening the time when certain devices, useful in only a very restricted way, shall be given to public use. While these suggestions were made in good faith, it is perfectly obvious that the Patent Office could not be placed in the position of determining the value of an invention, a thing which is in almost every case problematical. The value depends upon the utility and demand, and this cannot be calculated in the Patent Office, and to draw the line between inventions meriting full protection and those which do not, would be impossible. Neither could an inventor be compelled to disclose his conceptions to those to whom they would be most useful, since an invention is the product of the brain and therefore the sole property of the inventor. The present seventeen-year term of absolute protection can hardly be considered too long for a man to have possession of his brain child.

The International Congress.—Preparations are now going forward in Washington looking to the entertainment of the forthcoming meeting of the International Congress of the Union for the Protection of Industrial Property. This meeting is to be held in Washington in the month of May, 1911. The congress is expected by those having charge of the arrangements to be the most important of its kind ever held. It will be attended by many distinguished representatives. The Treaty of Paris of 1883 will be up for discussion, and important amendments will be made to that treaty. M. Morel, the director of the International Bureau of Berne, is in charge of the programme which will be brought before the conference. This is the fourth congress to be assembled, and in addition to those nations which adhered

As we at the present time enjoy the lux-twenty Latin-American countries have been invited to send delegates, and are expected to accept. As most of these delegates will be accompanied by their wives and daughters, a very large assemblage will be prepared for. Washington is at the height of its beauty in May, and the foreign visitors will have a chance to see the capital in its most attractive aspect. The conference of Washington will be known as a "Diplomatic Congress," many of the delegates being distinguished diplomatists and savants. The Department of State will have charge of the congress, and the United States delegates have already been commissioned by the President. They are: Hon. Edward Bruce Moore, Commissioner of Patents, chairman; Hon. Frederick P. Fish, of Boston; Hon. Charles H. Duell, of New York, ex-Commissioner of Patents and former Justice of the Court of Appeals of the District of Columbia; Hon. Robert H. Parkinson, of Chicago, and Hon. Melville Church, of Washington. The conference will command the interest of the manufacturers and inventors of the United States who look to it for the accomplishment of many reforms which will work to the benefit of international trade relations.

Brief Notes on Inventions

U. S. Patent 1,000,000.—The last United States patent issued in 1910 is numbered 980,177. It is thought that patent numbered one million will issue some time in the late spring or early summer of this year. At one time the starting of a new series in order to avoid the high numbers was suggested, but it has been decided to make no change, and the numerical numbering of the succeeding issues will continue as before.

Patents and Politics.—Patents have not only influenced commercial affairs, but have also had a political force, and patent litigation has, at least indirectly, played a large part in the nomination and election of one President of the United States. Except for a larger retainer opportunely received by Abraham Lincoln in an important patent suit, it is doubtful whether he would have entered into the Lincoln-Douglas debates which led up to his nomination for the high office. The story goes that Peter H. Watson, a leading patent attorney of his time, had charge of the McCormick reaper interests and it was decided to seek the services of Mr. Lincoln in a patent suit being tried in the Illinois district. When Mr. Watson sought Mr. Lincoln he met the latter holding a letter in his hand. After a consultation, Mr. Lincoln agreed to enter the case and a retainer of several thousand dollars, a large fee for the time, was handed to him. As the conversation proceeded Mr. Lincoln tore up the letter he was holding, and remarking that it required explanation, told Mr. Watson he had just received a request from the Illinois Republican Committee for him to engage in a series of joint debates with Stephen A. Douglas. It is easily understood that he appreciated the invitation and all the opportunity meant for him. He told his caller that after carefully pondering the whole matter, he had been obliged, because of his financial condition, to decline the invitation and had done so in the letter which he had just torn up; that the retainer he had just received put him in a position to render the political service desired and that he would write a different letter and agree to enter upon the debates. The rest is well-known history.

Trade-Marks and Imported Goods.—In seeking to protect domestic manufacturers or traders as well as traders and manufacturers located in any foreign country which affords similar privilege to citizens of the United States, the trade-mark act approved February 20th, 1905, in Section 27 provides that no article of imported merchandise which shall copy or simulate the name or trade-mark of any such trader or manufacturer shall be admitted to entry at any United States Custom House. To aid in enforcing this salutary prohibition, the statute further provides for the recording in the Treasury Department of the name and residence of the maker, and the locality in which the goods are manufactured, and the certificate of registration of the registered trade-mark. While this privilege is open to the thousands of trade-mark registrants who must be interested in the subject, it is surprising to learn that the number of persons, firms, and corporations who have actually availed themselves of the privilege of so recording with the Collector of Customs since the act of 1905, is only about eighty.

Some Ancient "Modern" Improvements.—Water heating devices including hollow grate bars through which water is caused to circulate were used in ancient Roman boilers; the original nickel-in-the-slot machine is a thing of the middle ages; rotary engines were known in the eighteenth century; vehicles registering the distance traveled are said to have been used by the Chinese hundreds of years ago; tobacco was doubtless used in Asia before the discovery of America; wire making is described in Exodus; dolls

whose limbs were moved by the pulling of strings amused the children of the early Egyptians, and explosive engines were devised early in the last century wherein motion was given to pistons by the explosion of gun powder. In fact, an explosive engine was patented in 1807 in France in which a mixture of hydrogen and air was exploded and utilized to move a carriage (practically an automobile). This machine even ignited the explosive charge by an electric spark.

The Government and the Inventor.—That the government of the United States is not generous in its treatment of inventors for the use of patented inventions is evidenced by an official report of a Cabinet officer. The Treasury Department contains many instances of the use by the department of patented inventions for which nothing was paid the inventor and patentee. In one case the patentee made affidavit that the use of his formulas has saved the government from $5,000 to $8,000 per year, and his chief made a signed statement to the same effect. The inventions made by government employees and officials include nearly all classes and range from armor plate, cartridge belts and field stoves in the army and navy through erasers and cutlery cleaners to the more peaceful agricultural inventions relating to the treatment of hog cholera, and the inventions have been connected with practically all of the departments of the government. The list of patentees contains many well-known names, including General Anson Mills, U. S. A.; Willis Moore, Chief of the Weather Service; General A. W. Greely, U. S. A.; General Wm. Crozier, U. S. A.; Admiral Hichborn, U. S. N., and numerous other officers of the army and navy. While some of the patentees have reaped a reasonable reward, in many cases absolutely nothing has been paid them in return for the exercise of their inventive powers. All this is now changed by a recent law empowering the Court of Claims to act in patent cases against the United States.

Sheet Aluminium.—Sheet aluminium, states the *American Machinist*, makes better vise jaws than either copper or brass. It can be obtained in any thickness from machinists' supply houses.

The Tungsten Lamp on Railroads.—In the *Yale Scientific Monthly* the general superintendent of motive power of the Pennsylvania Railway states that there is no doubt that the tungsten lamp will replace the carbon lamp for train-lighting work. The success attending its use may be attributed to the development of the so-called "hot circuit." By means of this method, instead of turning the current completely off from the lamps when light is not required, the lamps are merely disconnected from the main batteries and joined to one or two "hot circuit" cells, sufficient current being thus passed through the lamps to show merely a faint red at night. This arrangement minimizes the breakages of the filament.

Electric Lights for Draftsmen.—Electric lights for drawing boards in an office where the work requires very long drawings, states the *Engineering Record*, are suspended from wires strung below the ceiling parallel with and directly over the boards. The connections are taken from convenient ceiling outlets and the lamp cords are permanently tied to small white porcelain spool insulators. These insulators are strung on the wires by passing the latter through the nail hole. Sufficient cord hangs from the insulator to allow the lights to be dropped quite close to the boards, and enough slack is left between the insulator and outlet plug so that the lights can be moved a considerable distance along the wire, and thus be placed directly over the desired point without moving the drawing. This is particularly advantageous in studying completed drawings.

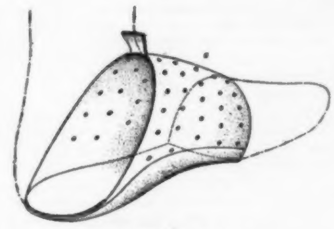
RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

The weekly *Index of Patents* issued by the *United States Patent Office* will be found in the *Scientific American Supplement*.

Pertaining to Apparel.

FOOT GLOVE BRACE. — HIERONYMUS FISCHER, 54 Grand Avenue, Corona, N. Y. In operation, the brace illustrated herewith is first placed on the foot and the stocking adjusted with reference to the said brace prior to placing the foot in the shoe. When the



FOOT GLOVE BRACE.

foot is placed in the shoe it will be found that the leather of the brace adheres to the leather and lining of the shoe much more snugly than with the stocking foot, therefore the foot, when properly incased in the covering, is prevented from plunging forward into the toe of the shoe.

COLLAR.—L. B. TIM, New York, N. Y. This invention relates to certain improvements in that type of turn-down collar in which the rear position is so constructed as to separate the necktie from the head of the collar button in order to prevent the necktie from being injured while being moved lengthwise past the collar button in adjusting or tying the tie.

SHOE LACE RETAINER.—F. M. WILLIS, New York, N. Y. In this construction the inventor provides a member which is secured to the body of the shoe adjacent the upper edge thereof, and is so constructed that it will receive and resiliently retain the bow of the knot in the shoe lace, and be partly concealed thereby, and will independently receive the free end of the shoe lace.

Electrical Devices.

TELEPHONE MOUTHPIECE. — L. STEINBERGER, New York, N. Y. The mouthpiece has upon its outer peripheral edge a strengthening member of annular form, separate from the mouthpiece and detachably connected therewith. The invention comprehends mounting upon the mouthpiece adjacent to the above edge, a protecting member and legend plate having substantially the form of a flat ring, and adapted to display legends, including telephone addresses and members—this plate being normally locked in position by aid of a locking ring.

ELECTRICAL FUSE TONGS.—A. M. HUBBARD and C. H. CAUSEY, St. Anthony, Idaho. The invention is an improved insulated tongs or hand-gripper for holding and handling electrical fuses or devices safely. By seizing the handle portion with one hand and the outer portion of the handle with the other hand, the cam may be rotated as required to open and close the jaws.

ELECTRIC SIGN.—A. V. DIEHL, Englewood, N. J. More particularly the invention relates to a sign in which each letter or character is formed on a separate block adapted to be detachably secured to a frame or support. Each letter is formed of a plurality of incandescent electric lights, and the letter blocks and frame are so formed that when the letter blocks are placed in position, the electric connections to the lights are automatically completed.

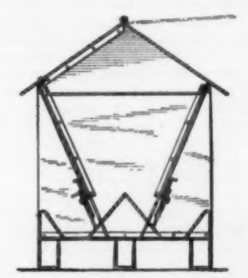
Of Interest to Farmers.

DOUBLE BREASTED HULLER COTTON GIN.—J. L. HART, Chickasha, Okla. The object here is to provide a device having a series of transverse rods to which the gin ribs may be attached and from which any one of a number of ribs can be conveniently removed without disturbing the other ribs in the row. The individual gin ribs may be attached or detached without necessitating the use of screws, bolts, or other fastening devices.

CANE KNIFE.—E. M. HIBBLER, Iris, Miss. By the construction in this invention, the blade can be set to any desired angle and secured in such position and thus adapted for use in any manner required. The handle is composed of sections united together by threading a tenon at the end of one section into a socket in the end of an adjacent section. These sections may be used interchangeably to adapt the knife for use as a scythe, as an ordinary cane cutter, and for use in close quarters.

CORN PLANTER.—J. VINTON, Spokane, Wash. The purpose of the invention is to provide an attachment for corn planters, which will enable the operator without any mathematical procedure, and at a glance to determine the exact point at which to commence the new row, in order that the hills may be in a straight line both longitudinally and transversely of the field.

HOG FEEDING APPARATUS.—CHARLES G. HOWARD, R. F. D., No. 3, Box 47, Exeter, Neb. The invention provides an apparatus for feeding cattle and more particularly swine, which may be arranged to regulate the rate of delivery of the food; provides an apparatus where the door for delivering the food may be



HOG FEEDING APPARATUS.

readily and quickly adjusted; and provides a construction which is simple, economical, and durable. So far as possible all the members shown in the engraving are constructed from metal, the sides and top, as well as the framing channels below the floor of the troughs, being of sheet metal, while the rods, bolts, and disk forming the lock for the doors are preferably formed of bar and plate metal.

MOWING MACHINE.—M. G. OTIS, Aniwa, Wis. This invention provides a construction wherein is provided means for driving the mower knife; provides a construction whereby the carrier is rapidly actuated to answer the expediences which arise in the operation of machines of this character; provides means for connecting the draft mechanism to the cutter bar; and provides an operating mechanism for reciprocating the cutter bar.

Of General Interest.

RIVER BANK PROTECTOR.—T. W. MAXEY and A. A. ESTEP, Fowler, Colo. This invention refers to a device adapted to be used to protect the bank of a river, stream, or other body of water from being washed away, and which also may be used to change the channel of a river or stream. It provides a boom which will protect the bank, with a coarse-meshed screen on the outer side and a fine-meshed one on the inner side, whereby the current is retarded in a gradual manner.

PALMITIN WATERPROOFING COMPOUND AND PROCESS FOR MAKING THE SAME.—E. MAS, New York, N. Y. This invention pertains to a compound and the method of making the same, and more particularly relates to the treatment of palmitin in a solid and non-oleaginous condition, so as to make use of it as forming the base for waterproofing compounds associated with other substances in a dry powdered form, to act as a vehicle.

HAM PUMP.—C. S. HARDY, San Diego, Cal. The object here is to provide a device especially adapted for introducing pickle into hams, but also capable of use as a measuring device, which is operated by the pressure of the liquid to be pumped, and wherein the quantity of liquid ejected at each stroke of the pump may be varied. Mr. Hardy has also invented another ham pump for use in forcing pickle into hams wherein the plunger will be operated by the pressure of the pickle to alternately fill and discharge the barrel of the pump.

SANITARY PILLOW.—V. REBHUN, Schaghticoke, N. Y. This pillow comprises a skeleton frame having inwardly-yielding end supports for the pillow cover, the supports being hinged to fold against the base of the frame, and provided with spring members arranged to tend to swing the end frames outwardly when the latter are operatively set up.

WEED EXTERMINATOR.—G. E. WHITNEY, Lane, S. D. Among the principal objects which this invention has in view are: To provide an apparatus, by the operation of which the heads or bodies of weeds may be pierced and have inserted therein lime or saliferous material of any suitable character fatal to the plant; and to provide an apparatus for the purpose described to pierce and spread the body of a plant, and to inject in the body the eradicating material.

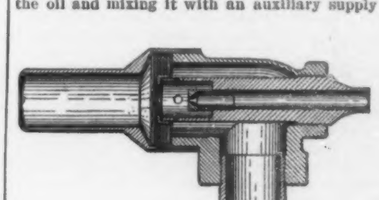
Household Utilities.

CONDIMENT HOLDER.—T. F. LACY, Sioux City, Iowa. The invention is an improvement in that class of condiment-holders which are provided with two or more compartments adapted for holding a corresponding number of different condiments, such as salt and pepper. All the principal parts may be struck up out of thin sheet metal, and the partition may be inserted and held in place without soldering or riveting solely by means of the inserted bottom.

CUSPIDOR TONGS.—J. R. EASTON, Marion, N. D. The more particular purpose in this case is to give the tongs such construction and operation that, by their aid the cuspidor may be grasped, washed, turned bottom upward, if need be, and released or turned back into its normal position, as desired, without the necessity of the operator placing his hand directly upon the cuspidor.

Heating and Lighting.

OIL BURNER.—H. L. ALBEE, East Douglas, Mass. In this case the invention relates to a burner of a type adapted to spray a suitable combustible oil, such as kerosene, and finely atomize it and mix it with a suitable quantity of air before supplying it to the burning nozzle. An object is to provide a burner with means for spraying a stream of oil and mixing it with a preliminary supply of air, and with means for further disintegrating or atomizing the oil and mixing it with an auxiliary supply



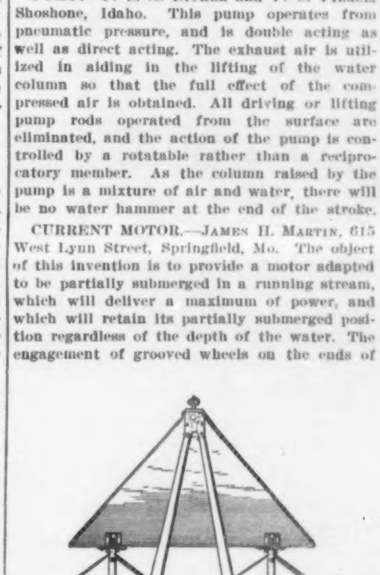
OIL BURNER.

of air. The illustration represents a vertical longitudinal section through the center of the device.

Machines and Mechanical Devices.

PUMP.—P. S. A. BICKEL and F. C. PIERCE, Shoshone, Idaho. This pump operates from pneumatic pressure, and is double acting as well as direct acting. The exhaust air is utilized in aiding in the lifting of the water column so that the full effect of the compressed air is obtained. All driving or lifting pump rods operated from the surface are eliminated, and the action of the pump is controlled by a rotatable rather than a reciprocatory member. As the column raised by the pump is a mixture of air and water, there will be no water hammer at the end of the stroke.

CURRENT MOTOR.—JAMES H. MARTIN, 615 West Lynn Street, Springfield, Mo. The object of this invention is to provide a motor adapted to be partially submerged in a running stream, which will deliver a maximum of power, and which will retain its partially submerged position regardless of the depth of the water. The engagement of grooved wheels on the ends of



CURRENT MOTOR FOR RUNNING STREAMS.

shafts or rods with the tracks retains the upper and lower run of chains horizontal, and insures that each vane or blade will be entirely submerged when on the lower run and entirely out of water on the upper run. A chain belt leads from a sprocket wheel and may connect with any suitable mechanism for utilizing power. The illustration is a plan view of the improvement.

BARREL TRUSSING AND HOOP DRIVING MACHINE.—CHARLES W. SHARROCK, Dorincourt, Grays, Essex, England. This invention relates to the manufacture of casks (which term is to be understood as including all articles of cooperage to which the invention is applicable) and has for its object to enable any number of permanent hoops to be fixed in

any position on a cask and with any desired degree of tightness during the process of assembling and bending the staves in a trussing machine as usual.

WATER WHEEL MECHANISM.—T. A. MACDONALD, Clifton, N. J. In the present patent a water wheel is rotatably mounted on a balance arm and is arranged to be swung downwardly into a running stream or upwardly out of engagement of the stream by means of a counter-balance on the opposite extremity of the arm. A second wheel acts as the counter-balancing weight so that either wheel can be swung up or down as occasion demands, and use can be had of either wheel as a motive power.

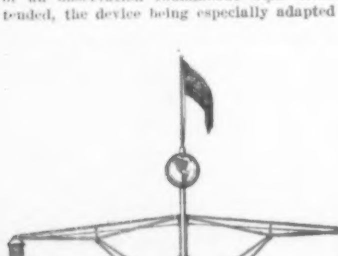
RUBBER TUBE CLEANER.—J. WIECHMANN, Albany, N. Y. The aim in this case is to provide a cleaner designed for thoroughly removing the scale or other incrustation on the outer or on the inner surface of the boiler tube, the cleaner having a rotating hammer head for use within the tube, to loosen the incrustation by blows in rapid succession.

Railways and Their Accessories.

RAIL ANTI-CREEPING DEVICE.—J. G. WOLFE, New York, N. Y. The intention of the inventor is to provide a new and improved rail anti-creeping device, which is simple and durable in construction, easily applied, and arranged to prevent creeping of the rails in the direction of their length incident to the action of the wheel of passing trains.

Pertaining to Recreation.

OBSERVATION ROUNDABOUT.—VINCENT H. DAVISON, P. O. Box 1991, Goldfield, Nev. The accompanying illustration is a side view of an observation roundabout with arms extended, the device being especially adapted for



AN OBSERVATION ROUNDABOUT.

use at fairs, expositions, etc., whereby a large number of people may be entertained. It is capable of elevating a number of people to a considerable height above the ground, and then rotating so as to give the patrons a good view of the grounds and the surrounding country.

Pertaining to Vehicles.

SECTIONAL WIND SHIELD.—W. G. COX, Albany, N. Y. The aim in this invention is to provide certain new and useful improvements in sectional wind shields for automobiles and other vehicles, whereby the upper section of the shield can be readily swung upward into an extended position or downward into a folded position, or into any desired intermediate position, and to securely lock the section therein in a simple and convenient manner.

WHIFFLETREE.—O. H. SMITH, New Brunswick, N. J. Among the principal objects which the invention has in view are: To provide a whiffletree wherein the shoulder load on the team is cushioned; to provide a cushion draft equalizing construction; and to provide a construction wherein the equalizing leverage of the swingletree may be varied.

POWER TRANSMISSION ATTACHMENT FOR AUTOMOBILES.—E. ZYBACH and G. BRAUN, Duncan, Neb. As this attachment is constructed, it is adapted to support the rear axle of the automobile, with the wheels mounted on the axle raised from the ground and to hold in frictional contact with the wheels of the automobile, driving wheels, the driving wheels being keyed to a shaft on which is mounted a pulley which may be connected by means of a belt with the machinery which is to be driven.

BICYCLE GEAR.—F. V. WHITMAN, Walkerville, Mont. In the present patent the invention is an improvement in bicycle-gears, and the object of the inventor is to provide a driving mechanism, wherein the rotating crank shaft is replaced by oscillating elbow levers, and wherein a simple form of gearing connects the elbow levers with the driving wheel.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

A TREATISE OF ELECTRIC THEORY AND THE PROBLEM OF THE UNIVERSE. By G. W. de Tunzelmann. Philadelphia: J. B. Lippincott Company, 1910.

The modern development of electrical theory has been extended over the entire field of physical phenomena, for which reason there is a cosmical side to those researches of recent years which have given us our new electron theory. Throughout the work, the consideration of experimental detail has been avoided. The subject has therefore been developed from the physical rather than from the mathematical point of view; and except where it has been possible to arrive at the required results by quite simple and elementary mathematical methods, physical illustrations and explanations are employed in place of analytical demonstrations. On the whole, the author has attempted with a great deal of success the very difficult task of presenting in a form which will be intelligible to the ordinary physical student possessing only an elementary mathematical equipment, a connected outline of researches which cover many sciences. Starting with a chapter on fundamental electrical phenomena, which may be commended for its simplicity, the author passes to a discussion of units and measurement. Next he discusses the meaning and possibility of the mechanical theory of electricity. An important chapter is that on the ether, in which we find not only a historical review of ancient conceptions of the ether, but an excellent discussion of the contributions of modern scientific men to the theory, so that when we come to consider the chapter on "The Ether as a Framework for Absolute Motions," the reader is well prepared to understand the place which the ether takes in modern physical conceptions, and to understand the relations between the ether and moving matter. Modern discoveries in ionization are well handled in a chapter on "Conduction in Gases and Dielectrics." In the eighth chapter, on the Faraday-Maxwell theory and the electron theory, the author has perhaps done his best work. It is no easy task to present in a form which will be intelligible to the ordinary student, a connected outline of the Faraday-Maxwell theory, as developed in Maxwell's great treatise, as well as the various steps which have given us the electron theory. Perhaps from a popular standpoint, the most interesting chapter in the book is that on radio-activity in stars and nebulæ, in which the author has made excellent use of the discoveries of Rutherford and Soddy, and the investigations of Darwin and Poincaré. No doubt the most original section of the book, both in conception and treatment, is the chapter entitled "The Place of Mind in the Universe," in which the author extends the ordinary methods of physical inquiry to investigation of the nature of the primal intelligence as the logical outcome of the development of electrical theory into an apparently all-embracing theory of the material universe. Most modern physicists have regarded the existence of forces as being entirely beyond the reach of physical investigation. Here however we find a scholarly endeavor to show the directive power of mind over energy, and therefore other matter, with the doctrine that our system of dynamics must be remodeled on the basis of energy in the place of mass. When that remodeling is undertaken, the author assures us that we shall begin to contemplate the ultimate possibility of a future remodeling in which life will replace energy as the fundamental basis of the physical scheme.

ROYAL PALACES AND PARKS OF FRANCE. By Francis Miltoun. Illustrated by Blanche McManus. Boston: L. C. Page & Co., 1910. 12mo.; 371 pp.

The works of travel by Mr. Miltoun are rapidly lengthening, and he has shown that he is a conscientious traveler and commentator as well. The present volume is particularly delightful, owing to the interesting range of topics which can be gathered under this head. Thus we have a chapter on the Evolution of French Gardens; The Royal Hunt in France, the Old Louvre and its History. The Louvre of Francis I. and its Successor; The Tuileries and its Gardens; the Palais Cardinal and the Palais Royale; Vincennes; Fontainebleau; Malmaison and Marly; St. Cloud; Versailles; St. Germain en Laye; Rambouillet; Chantilly, and Compiegne. The illustrations are charming; and the little maps are particularly happy. Like all books issued by L. C. Page & Co., the binding is particularly attractive, the combination of green and cream harmonizing beautifully with the red cloth and its gilt stamping.

DIE FORDERUNG DES TAGES. By Wilhelm Ostwald. Leipzig: Akademische Verlagsgesellschaft, 1910. 8vo.; 603 pp.

We have before us another volume from the pen of that prolific and inspired writer who, after earning for himself the highest reputation as an original worker, teacher, and author in the field of chemistry, has for some years past devoted his main strength to the advancement of philosophical thought. There is so much that occurs to one's mind in recording the impressions gathered in perusing a book by this remarkable man, that one is tempted to exceed the limits within which such a review as this must necessarily be framed.

If there is anything that distinguishes Ostwald perhaps more than any other characteristic, it is his great breadth of view and the many movements in which he has taken an active interest, and to which he has lent his authoritative support. These facts are reflected in the table of contents of the volume before us, which is a collection of essays, many of them originally placed before the public in the form of addresses delivered orally before various assemblies.

The first essay, the title of which has been adopted also to name the collection as a whole, gives us an insight into some incidents in the author's private life, and especially in the early days of his career, when he was beginning to reap the first fruits of his now universally acknowledged genius. Especially for those whose privilege it has been to come into personal contact with the great teacher, as it was ours, there is a peculiar pleasure in being allowed to thus enter into a knowledge of some of the more intimate thoughts which are closely bound up with Ostwald's personal as well as his public life. Something of the same spirit is felt also in reading many of the other essays under the cover of this book. The significance of the title is understood when it is given with its context. It is a partial quotation of Goethe's saying, "What is thy duty? To obey the demands of the day."

While the first essay is given an entire section to itself, the remaining papers are classified under seven sections, each comprising discussions centering around some one of those many topics to which Ostwald has contributed thought and action.

The second section is devoted to "General Energetics." It is perhaps hardly too much to say that the all-importance of the energy concept is a dominant note in nearly all Ostwald's writings and reflections. It would be surprising to find a book such as the one here discussed, written by the eminent German chemist, in which the energy concept did not figure prominently.

The third section deals with the general theory of science, and discusses such topics as the classification of the sciences, the relation of theory to practice, the "technique" of invention, and also includes one or two papers of more specifically chemical nature.

The fourth section is headed "Psychology and Biography." Those familiar with Ostwald's works will know that he has devoted considerable study to the psychological phenomena presented by the life history of the great pioneers of science. Reflections of this nature, and a somewhat diverse selection of other topics of psychological content, form the subject matter of this section. The last paper is a biography of Arrhenius, one of Ostwald's most famous pupils, to whom this book is also dedicated.

The fifth section deals with questions relating to arts, science, and civilization and some of the problems which their modern development presents. The sixth section is devoted entirely to the movement for an international language, of which Ostwald has been an enthusiastic advocate and supporter for some years past.

Section seven is a collection of papers on the subject of Public Instruction. Among these one, a comparison of German and American universities, is of peculiar interest to us in this country, and cannot be valued too highly, as expressing the opinions and impressions of one who has qualifications far above the ordinary for dealing with the subject.

The eighth and last section again contains but a single paper, which is in many respects a counterpart of the first essay. While this latter dealt with some impressions taken from the early days of the author's career, the last paper, which is headed "Nach Stockholm," brings before us a picture of what might be said to present the world's expression of the consummation of the great man's successes. It is an account of his journey to Stockholm and the Court ceremonies attending the bestowal upon him at the northern capital of the highest distinction awarded to scientific investigators, the Nobel prize. Here again a number of personal touches lend peculiar interest to the reading of the closing pages, and one lays down the book with a feeling of having been in intercourse with a great mind, and with a man through whose life runs that thread of romance which is the privilege of the great, of those destined for important missions, and raised by character and circumstance above the level of the petty commonplaces of life.

WHO'S WHO IN AMERICA. Volume VI. 1910-11. Edited by Albert Nelson Marquis. Chicago: A. N. Marquis & Co. 12mo.; 2436 pp. Price, $5 net.

This is a biographical dictionary of notable living men and women in the United States, revised and reissued by Brainerd. It aims to give a brief personal sketch of every living man and woman in the United States who by position or achievement makes his or her personality of general interest, and tells just the things every intelligent person wants to know about those who are most conspicuous in every walk of life. A valuable feature of the book will be found in the addresses appended to each name, so that it is an unrivaled list for circulation if the highest class of patronage is desired. Addresses of leading Americans are given in all parts of the world. Thus the book comprises not only the best attributes of the best biographies, but is also a directory to those living people of America in whom almost everybody is interested. There is in addition a geographical index which has been compiled with the greatest possible care. It groups by States, cities, and post offices all of the names in the book, making it easy to find quickly any name. The amount of labor in compiling a book of this kind, to say nothing of the printing of the same, is almost appalling. It is printed on very thin opaque paper, and the volume is bound in handsome red cloth. It will prove useful in every library.

THE MINUTES OF THE EXECUTIVE COUNCIL OF THE PROVINCE OF NEW YORK. Administration of Francis Lovelace, 1668 to 1673. Edited by Victor Hugo Paltsits, State Historian of New York. Albany, 1911. 4to.; 386 pp.

This is an elaborately annotated volume accompanied by a body of collateral and illustrative documents. The book shows erudition of the very first order and the matter presented is of the highest historical importance. No expense has been spared to render the publication extremely accurate. The book itself is beautifully gotten up and there is a most interesting map of Manhattan Island executed from a manuscript; this is in a pocket at the back of the book. The office of the State Historian of New York is admirably conducted, and the several volumes which we have had the pleasure of reviewing show that the work which is done has been well done.

DRYING MACHINERY AND PRACTICE. A Hand Book of the Machinery and Practice of Drying and Desiccating, with Classified Description of Installation, Machinery and Apparatus. By Thomas G. Marlow. New York: D. Van Nostrand Company. London: Crosby Lockwood & Son, 1910. 8vo.; 326 pp. Price, $5.

The subject of drying and desiccating has been woefully neglected. There is not a class of technical literature where the books on the subject are so meager or even non-existent. For this reason the present volume will be very warmly welcomed, and it is interesting to note that the author has in preparation a companion volume dealing with the processes and patents for drying and desiccating. When this appears the subject will be admirably covered. The book is well illustrated with engravings and diagrams. The subject is roughly divided into chapters which deal with drying by gravitation, absorption, and condensation; then the subject of mechanical drying is taken up, including pressure and centrifugal force. This is followed by a chapter on drying or evaporation; a chapter on methods of applying the heat follows, then the methods of removing the vapor, the handling of the material, installations, etc., come in for a full share of attention. There is an excellent bibliography containing references to technical literature and a complete glossary of terms. At the back of the book there are forty-three pages of advertising, giving useful addresses of manufacturers of machinery. In a very special book of this kind advertisements are far from being a detriment.

HEATON'S ANNUAL. A Commercial Hand Book of Canada and Boards of Trade Register. Seventh Year. Toronto, Canada: Heaton's Agency, 1911. 12mo.; 540 pp. Price, $1; postage extra.

The information which a business man requires every day is arranged in logical sequence in the first part of the book. The information has been compiled from the latest blue books and submitted for revision to the different departments of the Dominion. The boards of trade register contains descriptions of towns with notes of boards, offering investments and individuals seeking employment. The book is a mine of statistical information relating to the Dominion of Canada.

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12368) C. A. E. H. says: Will you kindly explain to me through your interesting column how it is that we are never able to see the stars when they are closer than 10 or 15 degrees to the horizon? When I read that a star rises or sets at a certain time I am often unable to find it because I cannot see it when it is close to the horizon. I am almost sure that this condition is not due to cloud or mist, as I have noticed it on the clearest of nights in both summer and winter. A. The reason why the fainter stars are not seen to rise, nor till they are some degrees above the eastern horizon, is that their light must traverse a much deeper layer of air and is lost by absorption. At the horizon the light of a heavenly body must traverse 35.5 times as much air as in the zenith, and at 5 degrees above the horizon the light must traverse 10.2 times as much air as at the zenith. The air near the earth is always laden with dust and water vapor, both of which absorb much light. Only the brightest of the heavenly bodies can be seen to rise.

(12369) D. H. B. says: Will you kindly give me through your Notes and Queries the temperature of steam at 10, 20, 30, 40, 50, 80, 100, and 200 pounds pressure? A. They are respectively 240, 259, 274, 287, 298, 324, 338, and 388 deg. approximately on the Fahrenheit scale.

(12370) A. L. asks: I have had some trouble looking up the chemical name Sodium aurachloride in your book known as the "Scientific American Cyclopedia," which is in the pages of Photography under the formula name of Faded Photographs. I have looked for this book in my chemical dictionary, also catalogs, and cannot find this name. Will you assist me in finding another name for this chemical? A. Sodium aurachloride is a mixture of equal parts, by weight of gold chloride and sodium chloride. It is used in toning photographic prints. You can use the gold chloride and sodium acetate for toning without the addition of the sodium chloride. The name is given in many of the lists of chemicals. It is more frequently called chloride of gold and sodium. "The Scientific American Cyclopedia of Formulas" supersedes "The Scientific American Cyclopedia of Receipts, Notes, and Queries."

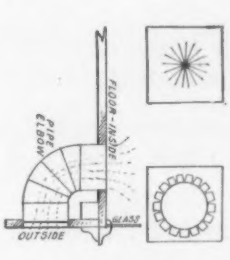
(12371) C. F. L. asks: Please quote me a list (in your Notes and Queries column) of the more important papers on aeronautics published in the SCIENTIFIC AMERICAN SUPPLEMENT. A. Lack of space in this column will not permit of our publishing here such information as you require. We have prepared a special list of "Important and Instructive Articles on Aviation," published in the SUPPLEMENT, which we are sending to your address by mail. We shall be pleased to send a copy of the list to any of our subscribers on request.

(12372) T. C. W. says: 1. Will you kindly state through the columns of your paper what are the differences in watts per candle of two or three of the well-known electrical illuminants, say the mercury vapor, tungsten, and carbon forms? A. The carbon filament incandescent electric lamp is made to consume 2½ to 3½ watts per candle; the tungsten filament is rated at 1¼ watts per candle; the Nernst glower lamp may be put down at about 1½ watts per candle; and the Mazda filament varies from 1.15 to 1.45 watts per candle according to size. The Moore tube may be taken at about 1 1/5 watts per candle, and the mercury may be given at about 0.7 to 0.9 watt per candle, but if a reflector is used this will rise to 0.5 to 0.6 watt per candle. All these results are to be considered as average results with fresh lamps. With old filaments the current consumption per candle rises. 2. Some years ago I read that the theoretical efficiency of a carbon lamp was about 5 per cent; that is, only 5 per cent of the current used was available as light, the rest being dissipated as heat. Is any other percentage figure available, and is it anything more than guesswork? A. The luminous efficiency of an incandescent 3.1 watt per candle lamp is thus stated in the new edition of the "Standard Electrical Engineers' Pocket Book," which we send for $4: "The proportion of the energy within the visible spectrum to the total energy dissipated in the filament is about 3.5 per cent." The topic is discussed at greater length than we can make space to quote.

(12373) F. E. H. asks: Does water when frozen expand or contract? And while it is possible to burst hydrants which have been frozen, by thawing them out, is it not just as possible to burst a hydrant by hard freezing? A. Water expands at the moment it freezes, and for this reason ice floats upon water. After it is frozen the ice contracts by cooling just as any other stone does. You will see from this that a water pipe or hydrant is burst in freezing, and not in thawing. It is not possible to burst a water pipe by thawing the ice in it, since ice contracts in melting. The reason for the popular and erroneous impression that pipes burst by thawing is that they leak when the ice melts and the water begins to flow. The break was in the pipe while it was frozen. It is discovered when the water begins to flow, after it is thawed out. Everybody knows that ice floats on water, and hence must expand on freezing. It must then contract upon melting. The rest follows as a matter of course.

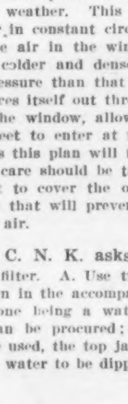
(12374) C. H. says: I wish to know how, generally, to determine the rate of the wind in miles per hour by the use of a windmill or some simple machine. You may answer this by publishing an article in the SCIENTIFIC AMERICAN. A. There is no way in which you can obtain the velocity of the wind by means of a windmill, excepting you make a windmill which will move with great uniformity and with very little friction. Make it as good a machine as the anemometers usually employed for the purpose, and it will answer just as well. You must then compare it with a standard anemometer till you determine the number of turns your machine makes for a mile of the motion of the wind, and get the allowance to be made for friction and lag. The machine can then be rated. Of course it must have a registering device to show how many turns or miles it has traveled.

(12375) A. H. P. asks how to ventilate a shop window. A. Take two square pieces of tin and draw circles on them to fit a five-inch stove-pipe elbow, as shown in the dotted line in cut, and cut the tin from the center to the circle, as marked in the same drawing. Bend the points back and cut off to leave a flange of about one and a half inches, as shown. Cut a hole 5 inches in diameter in the floor of the window close to the glass, and another hole of the same size through the wall beneath the window, making an opening into the street. Fit the pieces of tin to these holes, and insert the stovepipe as indicated in cut. Place wire net-



ting over both holes. Then cut a few holes at the top of the window to allow the air to circulate. This will keep the windows frostproof in the coldest weather. This principle, which keeps the air in constant circulation, is a simple one. The air in the window (which was inclosed) is colder and denser and hence has a greater pressure than that in the store. It therefore forces itself out through the holes at the top of the window, allowing the cold air from the street to enter at the bottom. Any one who tries this plan will find it very satisfactory, but care should be taken in trimming the floor not to cover the opening with any heavy article that will prevent the free circulation of the air.

(12376) C. N. K. asks how to make a household filter. A. Use two stone pots or jars, as shown in the accompanying engraving, the bottom one being a water jar with side hole, if it can be procured; otherwise, if no faucet can be used, the top jar can be removed to enable the water to be dipped out. The top



jar must have a hole drilled or broken in the bottom, and a small flowerpot saucer inverted over the hole. Then fill in a layer of sharp clean sand, rather coarse. A layer of finer sand, a layer of pulverized charcoal with dust blown out, then a layer of sand, the whole occupying one-third of the jar.

His Life in His Hands

(*Continued from page 133.*)

the drawers well secured to prevent slipping, and adds a pair of heavy woolen socks.

If the water be cold, two such suits may be worn. If the depth to be negotiated is great, cotton soaked with oil is put in the ears or a heavy woolen cap pulled down over them. Shoulder pads, if worn to take the weight off the helmet, are next tied on, after which the diver wriggles into his heavy suit of rubber and canvas, sleeve expenders being used by the attendant to make it possible to get into the dress. Next come the inner collar and the breast plate, which are secured with clamps to the rubber dress, the utmost care being taken in this operation not to tear or pinch the rubber. Finally, the shoes are fitted on, and the rubber gloves clamped to rings in the sleeves.

The helmet is last to go on, and never before the valves and telephone had been tested. The attendants start to pump as the helmet is clamped home. The helmet, of course, is attached to the pump with a rubber tube, which is canvas and wire protected. No diver descends, after the helmet is put on, until he has tested the outfit for several minutes and found that his air supply is sufficient and the pump working properly. But neither does he delay unduly, for the position in which he finds himself is the reverse of comfortable.

He is supplied with a life line, with which he can signal, should his telephone get out of order, and by which he may be drawn to the surface, should he become helpless for any reason. He must take great care when walking about on the bottom not to foul his life line, or his air tube, and for this reason must always retrace his steps exactly to his starting point, if he has gone into a wreck or about any obstructions. For the same reason, two divers, working together, must be careful not to cross each other's paths.

And when the diver has slipped from the float, dock or vessel where his attendants and air pump are working, and dropped down rope or ladder to the new, cold, dim, greenish, often muddy, world under water, he finds at once a myriad of perils surrounding him. Any interruption to his air supply means death. In times past, many a good man has died miserably in the spouting stream of water which choked him from a broken or cut air tube. To-day, all good diving helmets are provided with a check valve, which prevents water entering from a cut tube, but the air in a helmet and dress would last but a few minutes were the supply interrupted. Divers may be lost in a wreck, may be overcome from pressure or apoplexy, or may have perils from without to contend with, especially in tropical waters, where sharks or crocodiles make the diver's life a matter of terror. Sometimes the life line may become so entangled in wreckage that it must be cut, and then there is danger of the diver not finding his way back to his boat or float, especially if the bottom is muddy and fouls the "seeing." But the greatest danger of all, of course, is that the tube be cut, or the diver faint. In either case, he is in desperate straits. If the man handling the life line "feels" anything wrong he will haul the diver up, willy-nilly, and regardless of the severe bleeding at nose and ears which will result from too rapid a rise to the surface. But if the diver be inside a wreck, or if his life line gets tangled in wreckage, such hauling would do no good. It is in situations like these that the slender connecting link of telephone wire means so much to the men who risk their lives far beneath the surface of the water.

Of the deadly dangers from shark and crocodile, there are tales innumerable One will suffice as typical. It is told by George Means, now a very old man, who walks on a wooden leg, but who for thirty years adventured with wreck and wrecking job, at the end of a slender tube and a life line. Had he possessed a telephone, he will tell you, his story might have been different, but his great adventure was before the application of that instrument to diving.

"It was in the Gulf of Mexico, and I had to go down to look up the condition of the 'Bella Marta,' sunk two years before, and supposed to contain a good deal of coin. The water was only nine fathoms, and I did not expect much trouble, but I got it. I had a good man on the line, and I thought my pump was all right, yet from the first I experienced difficulty in getting air. It was found out afterward that there was a leaky valve. I pulled for more, and for a while it came better; then I got to work in earnest. The water was clear as a bell, and I didn't have any difficulty at all in finding the hull, although she was half covered with sand. But I had all thoughts of her scared out of me in short order. I had crawled through some of her rigging and wreckage to go down in the hold—dangerous thing to do, but I could not help it. I was getting along nicely, and had the hatch almost broken through, when I saw a shadow about fifteen feet long above me. I knew it was a shark, and I was a badly scared man. Of course, I commenced working my way back as soon as possible, but I wasn't quick enough. The brute saw me and came at me slowly, jaws open wide and wicked eyes gleaming like sin. And I couldn't get out, because the way I had come was the way to his jaws—he was on the wrong side for me. I was in mortal terror lest he go at my tube, but he had eyes for bigger game. There was but one thing to do, so I drew my knife—luckily it was a good ten-inch blade—and waited. It was my first experience with sharks, and I was nervous; but the thought that my life depended on no one but me, kept my head clear. He came at me sudddenly, with a rush, and turned almost on his back, so as to give his scissor jaws a chance. That was my chance, and I gave it to him twice in the throat, slashing as much as I could. The water was red in a minute, and as I threw myself on my face I just prayed he would swim off to clear water. He did, I guess, because things were quiet for a while, and as soon as my heart stopped pounding long enough for me to get breath, I commenced to feel my way back again through the maze of woodwork, spars, wreckage, and old cordage through which I had crept to get at the interior of the hull. It was slow work, and hazy red as the water was, I was afraid to do much cutting of ropes for fear of cutting my own line. About this time, the air got scarce again, and I was in a desperate hurry, I tell you. I did finally manage to get clear, and, all unnerved, I gave the signal to haul up, when—see this here stump of a leg? Either that shark or another one came along just then and got the rest of it. I hauled with all my might, and the man at the line, 'feeling' something wrong, hauled too. I came up with a rush, my helmet full of water, and nearly choked to death. The blood was coming our of ears and mouth as well as my stump, and they gave me up for dead, but I pulled around. No, never dived any more; didn't want to, either. The company gave me a pension, and now I just enjoy it. But that's my pet nightmare—being tangled in a wreck, with a shark coming at me."

And for all its danger, its romance, and its difficulty, the rewards of diving are not great. A hundred dollars for an hour's diving job may seem princely pay, but when it is realized that such isolated jobs are few and far between, that the apparatus is expensive and the risk great, it does not seem too much. But the profession has this one recommendation—it requires comparatively little time, and a man has many spare hours to himself to turn to account in other ways, and as a developer of self-reliance, quiet bravery, and coolness as well as skill, it has few equals and no superiors.

Ice Cream as a Health Food

THE State experiment station at Ames, Iowa, has invented a new frozen dairy product called lacto, which contains large numbers of lactic acid bacteria in a dormant condition. Metchnikoff, the famous Russian scientist, who is at the head of the Pasteur Institute at Paris, says that in a considerable measure old age is caused by the putrefactive bacteria in the intestines. These bacteria produce toxic poisons which cause ill health, old age, and finally death. He recommends as a remedy the taking into the body of lactic acid bacteria. These are entirely harmless, and they produce an acid condition in the intestines which is fatal to the putrefactive microbes.

In certain districts of Bulgaria, where sour milk forms the principal article of diet, the people live to an old age not approached elsewhere. People in America do not take kindly to sour milk, and it was with the thought of furnishing lactic acid bacteria in a more palatable form that lacto was introduced.

The palatability of lacto is shown by an experiment carried on at Ames. Out of 179 persons who sampled lacto, 128 pronounced it very good, 37 good, 6 fair, and 8 poor. Comparing it with vanilla ice cream, 111 reported that they preferred lacto, 9 considered it equal to ice cream, and 59 preferred the ice cream. Comparing lacto to sherbet, 123 preferred lacto, 30 preferred sherbet, and 6 considered lacto equal to sherbet. At the college creamery both lacto and ice cream were made and sold at the same price last summer. An average of eight days' sales showed that 46.8 per cent of the sales were of lacto. This is a very remarkable showing for a new product.

Lacto is made of loppered whole or skim milk, with the addition of sugar, eggs, lemons, and flavoring material. It contains less fat than ice cream, but more protein. It has a much higher food value than sherbets and ices. Lacto can be made at a lower cost than ice cream. It can not be so easily adulterated with gelatin, gum, or corn starch. It is more digestible than ice cream, and can be eaten in almost any quantity without ill results.

Freezing does not hurt the lactic acid germs, and they retain their vitality even after the product has been stored for some time in the frozen condition. Bacteriological analyses of lacto show that it does not contain any other forms of bacteria than the lactic acid produces. This is notwithstanding the fact that no especial pains were taken to keep other bacteria out of the produce, and goes to prove that lactic acid is fatal to putrefactive bacteria.

Beating the Blizzard

WHAT is probably one of the largest undertakings ever begun is the establishment of an underground telephone conduit from Washington to New York city.

During the last inauguration, when Washington was in the grip of one of the worst storms experienced for many years, communication between the two cities was cut off for many days. Train travel was also badly crippled. It was during this condition of affairs that the idea of an underground telephone conduit system was considered, which could be operated despite the most destructive storms.

After consultation with the best engineers and the manufacture of specially heavy machinery the plans are being carried to completion, and it is hoped before another winter has arrived that the underground system will be in operation.

The conduit being laid is built of creosoted wood, which has been found to be the most durable wood. Conduits of this wood have been found by experience to last more than twenty years. In the cities it is expected to use terra cotta and cement, but in the open country to use creosoted wood.

A special cable has been manufactured for the purpose, and it is expected that when the system is placed in operation, all the business from Washington to Baltimore, Wilmington, Philadelphia and New York city will be handled through these underground wires, and any business the other side of New York will be, for the time being at any rate, by the overhead wires.

In case of accidents to the open wire plant, portions of the underground cable system can be connected to the overhead lines, enabling the company to continue its service without interruption around a break in the overhead line until the line shall have been repaired.

It is also planned to carry, in addition to the conductors for the telephone service, wires for the purpose of telegraphy, so that it seems certain that before the year 1911 shall have passed the capital of the nation will be forever relieved of the possibility of isolation from the principal cities of the East.

The route of the conduit follows for the most part those much traveled roads between New York and Philadelphia, then along the old Philadelphia and Baltimore turnpike, and the historic pike between Baltimore and Washington.

Soil Pollution by Hookworm

SINCE the discovery by Dr. Charles Wardell Stiles that the hookworm is responsible for the low mental and physical condition of the "poor whites" in many parts of the South, the problem of soil pollution has engaged the attention of the United States Public Health and Marine Hospital Service as well as of local health authorities.

Under the direction of Prof. Stiles and Dr. Charles R. Gardner, experiments have been conducted with a view to determining the length of time that hookworm eggs may retain their vitality in the soil under various conditions of drying and of temperature. From these experiments it appears that it is *not* safe to assume that the sand under and around a privy is entirely free from infection with hookworm even five months after the privy was last used, although the infection is considerabl~ reduced at the end of four months.

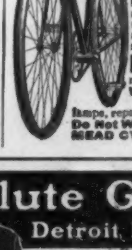
Under water, where the fecal material undergoes decomposition, most of the hookworm eggs are dead in about ten weeks, though some survive that period. It seems very probable that in three months all hookworm eggs in fecal material would be dead if this material is subjected to decomposition; at any rate, it would not be safe to use such material for fertilizer in less than three months.

Chloride of lime has been used as a disinfectant in solutions of about one pound to ten gallons of water. Experiments show that this solution does not kill all the hookworm eggs in from 22 to 40 hours.

Incidentally these experiments brought out the fact that eggs of various species of flies, including the common or "typhoid" fly, are still capable of development, and that the flies are capable of reaching the open air, even when the fly-blown material containing the eggs is buried under from 17 to 72 inches of sand.

Corrosion of Iron and Steel

AS a result of investigations of the corrosion of iron and steel, some manufacturers have been induced to produce a practically pure iron for culverts and pipes. Investigations in regard to fence wire have resulted in the improvement of the product of some manufacturers. Corrosion experiments extended to the use of paints in the protection of structures of iron and steel have made it possible now to design and specify a protective paint which will not only cover the metal, but will act as a rust inhibitor. It has been shown, too, that the life of wire fencing can be prolonged by painting it, at an expense of about one cent per rod.



Electricity

Coasting Clocks on New York Cars.—The Third Avenue Railroad of this city is about to install a number of coasting clocks on the cars of the Broadway-Forty-second Street line. The purpose of these clocks is to encourage motormen to economize current by permitting their cars to coast as much as possible. It is believed that a saving of ten to fifteen per cent may be effected in this way. It is proposed to offer a reward for motormen who make the best records, as registered by these clocks.

Telephone from London to St. Petersburg.—By means of the new submarine telephone cable from Dover to Cape Gris Nez, on the French coast, and suitable land lines, it will be possible to carry on a conversation from two ends of the wires in towns 850 miles apart, and it will be easy to speak from London to St. Petersburg. By introducing small self-induction or "loading" coils into each of the wires at spaces of about one mile apart, the defects of indistinctness and weakening of the sound noticeable in long cables of the old time have been overcome.

Electricity versus Hydraulic Power.—The Rothesay dock on the River Clyde recently installed a complete set of electrically-driven machinery in place of the hydraulic equipment previously used. A comparison of the two systems shows that the cost of installation was about the same in each case, while the working costs were less in the case of electric power, owing to the variable character of the work. Electric power could be used in conditions that did not permit of the employment of hydraulic power. When working under full load, however, the hydraulic system equaled the electric system in economy.

Auto-truck to the Rescue of a Composing Room.—Not long ago, the city electric service of Minneapolis was interrupted by a fire. This badly crippled one of the newspapers of the city, which was dependent upon the city mains for power to operate its linotype machines. It chanced that across the street there was a large garage, and an electric truck was hastily loaded with 105 storage battery cells used for electric vehicles. This was stationed just outside of the newspaper office, and current from the storage batteries, at 220 volts, was conducted into the composing room, permitting the operators to continue work until the city service was restored.

Losses on High Tension Lines.—In a paper read by Mr. West before the American Institute of Electrical Engineers, the relations between voltage and losses on transmission lines, by reason of coronal discharge, were discussed. He found by tests on the lines of the Central Colorado Power Company that with tensions of 50,000 and 60,000 volts on a line 180 miles long, the loss was not serious, even though the conductor was but 289 mills in diameter. But above a critical voltage of 75,000, the loss increased greatly, particularly under no-load conditions, but this loss could be reduced by using larger conductors.

Massachusetts Board on Electrification.—The Massachusetts Joint Board on Metropolitan Improvements has arrived at the conclusion that it would be inadvisable to compel railroads entering Boston to electrify their lines. While they recognize the fact that electricity would add to the comfort and convenience of the public, they point out that the science is now in a state of rapid change, and that under present conditions electrification would not result in economy, although it might ultimately result in a profit. It would probably require an increase in passenger fares and freight rates. They point out that electrification is not absolutely necessary on the grounds of public safety, and that if the roads were compelled to electrify now, they would have to postpone other more important improvements.

Engineering

Rapid Tunnel Construction.—A record of rapid tunnel construction was recently made on the Catskill aqueduct when a heading of the Walkill syphon tunnel, which is circular and 17 feet in diameter, was advanced 523 feet in a single month.

Pearl Harbor Dry Dock.—The excavation work on the big naval drydock at Pearl Harbor, Hawaiian Islands, is completed. The dock is to be 814 feet in length, 113 feet 4 inches in width at the entrance, and at mean high water it will have 32½ feet of water over the keel blocks. Pearl Harbor itself, which is being improved, will be open to navigation probably late in 1912.

Big Railway Profits.—The report of the Interstate Commerce Commission shows that the last year was the most profitable in the history of American railways. The total profits amounted to $940,076,363, which is nearly $112,000,000 greater than that of the preceding corresponding period.

The Traffic Figures of the Public Service Commission.—These show that 1,526,966,988 passengers rode on the various transportation lines in Greater New York during the year ending June 30th, 1910. The total for the previous twelve months was 1,396,086,252. The fares collected during the last year by the railroad companies reached the great total of over $76,000,000, while the operating expenses were over $43,250,000.

Curtis Turbine in British Navy.—The Curtis turbine has received its first trial in a new British cruiser, the "Bristol," and the results have exceeded anticipations. At the full power eight-hour trial, the mean power was 24,275 shaft horse-power, and the mean speed on the measured mile was 26.84 knots, which constitutes the "Bristol" the fastest vessel of her class in the British navy. At full power the water consumption was 12.2 pounds per shaft horse-power per hour for the main turbines only.

Wireless on Submarines.—A most interesting experiment was recently carried out in the British navy, when the largest submarine, "B-1," carried on wireless communication, when in the submerged condition, with the cruiser "Bonaventure." The antennæ were carried by a yard at the top of the mast at a height of some 30 to 35 feet above the deck of the submarine, and led down to connections within the submarine. The results prove that a fleet of submarines in the submerged condition could be directed from a larger ship at the surface.

Good Roads at Low Cost.—In an endeavor to stimulate interest in the good roads movement in the States through which it operates, the Pennsylvania Railroad has issued a pamphlet entitled "Good Roads at Low Cost." The booklet describes the split-log drag, a device which can be made by any farmer who follows the directions given in the pamphlet, and which has been used with telling effect upon country roads. Several of these devices have been placed at various Pennsylvania Railroad stations throughout the State of Pennsylvania.

Wire Gages Should be Standardized.—A correspondent has called our attention to the fact that there are some six or eight different gages in use by the wire and sheet mills of the United States. There is often a difference of two sizes in the gages, and a mistake in using the wrong gage often results in a great deal of expense to one party or the other. If merely the size and not the gage is given with an order, the mill must write back to ascertain the gage, and much valuable time is lost. Our correspondent suggests that either the manufacturers themselves should get together and decide on some one gage, or the government should take action in the matter. We commend this matter for discussion by users, dealers, and manufacturers of wire of all kinds, and of sheet metal.

Aeronautics

Long Voyage by a German Dirigible.—The German military dirigible "Gross III." left Berlin at 8:15 A. M. on the morning of January 31st, and landed at Gotha at 1:45 P. M. Thus in five and one-half hours, the airship covered about 160 miles. En route the airship passed over Halle at 11:30 A. M. An average speed of about 28½ miles an hour, was maintained during this, the first long flight of the year by a German dirigible.

Broken Propeller in Flight Fails to Cause Accident.—While flying in a strong wind at Havana on the 2nd instant, Aviator Ward, of the Curtiss team, met with a mishap. His propeller broke while he was at a height of 500 feet, but he managed to stop his engine and glide to the ground in safety. As similar accidents have occurred to monoplanes, it does not appear that the breaking of a propeller while in flight is necessarily serious.

A Seven-passenger Flight with a Monoplane.—On Thursday of last week (February 2nd), M. Le Martin, the French aviator, broke the world's record for passenger carrying by taking aloft seven passengers for a five-minute flight. Only a week ago Roger Sommer carried six passengers in his biplane. The new record, however, was made with a Blériot monoplane, which is all the more remarkable in view of the fact that most of the records of this sort have been made by the biplane type of machine.

A Record Military Cross-country Flight.—Captain Bellanger, one of the best cross-country flyers of the French army, started from the military aerodrome at Vincennes, near Paris, at 8:45 A. M. on February 1st in an endeavor to fly to Pau, a distance of some 500 miles. He landed at Bordeaux at 4:56 P. M., having covered the 360 odd miles with but two stops at a rate of over 40 miles an hour. The following day he completed his flight without incident. He used a monoplane for this new record-breaking trip. The flight from Paris to Bordeaux was first made by Bielovucci last summer in 7 hours 5 minutes actual flying time. He required two days.

Experiments with Man-lifting Kites in the Navy.—On Wednesday of last week an experiment was made with man-lifting kites at Santa Barbara, Cal. A string of eleven kites was sent up from the deck of the warship "Pennsylvania," and made to lift Lieut. John Rodgers 400 feet in the air. Lieut. Rodgers, seated in a sling a hundred feet or more astern of the vessel, made observations and took photographs during a quarter of an hour. While aloft he signaled to the officers on the warship, and gave them the results of his observations. This is the first time that tests of man-lifting kites have been made by officers of our navy. The "Pennsylvania" was traveling at a speed of 12 knots against an 8-knot breeze during the experiment.

Herding Cattle by Aeroplane.—The uses of the aeroplane are becoming more numerous every day, but novel indeed is the use to which his Blériot monoplane was put by M. René Simon at Houston, Texas, on the 27th ultimo, the opening day of the engagement there of the international aviators. M. Simon flew out over the plains, and rounded up a large number of steers by circling above them and swooping down upon them. When he had got the herd together, he succeeded in driving them right up to the fence of the aviation field by employing similar tactics. The cowboys looked on in amazement, and upon his alighting, they thanked Simon for having so cleverly and expeditiously herded the cattle. The following day, at the Houston meet, M. Roland Garros ascended to a height of 7,000 feet, and was lost in the clouds for fifteen minutes. M. Simon flew over the spectators in the grand stand only five or six feet above them—so close indeed, that the hats of many were blown off.

Science

The Flowing of Metals.—It is perhaps not generally known that one of the most important properties of metals employed in striking coins and medals, and stamping and shaping articles of jewelry, is that of flowing under pressure. Standard silver is remarkable for this property, which precisely resembles the flowing of a viscous fluid. The flow takes place when the metal is subjected to rolling, stamping, or hammering, and the particles of the metal are thus carried into the sunken parts of the die without fracturing, and a perfect impression is produced.

Good "Seeing" at Lick.—The excellence of the Lick telescope and the steadiness of the air when the conditions are good on Mount Hamilton are attested by the statement of one of the observers there, that double stars, whose components are nearly equal in brightness, can be measured if the distance between them exceeds one-tenth of a second of arc. What this means in accuracy of definition may be understood by remembering the fact that one-tenth of a second is equal to the apparent diameter of the head of an ordinary pin, viewed by the naked eye—if the eye could see it—at a distance of two miles.

Science of Colonizing.—Of all the colonizing powers, Germany makes the most thorough study of the physical conditions prevailing in her possessions, and especially of that all-important factor in colonial problems, climate. To the long series of climatographic memoirs heretofore published concerning German colonies has just been added "Das Klima von Samoa," by O. Tetens and F. Linke. This is much the most complete account of the climate of Samoa that has yet appeared, and is issued by the Royal Society of Göttingen, which has maintained a large observatory in Apia since 1902, under the direction of which a *reseau* of meteorological stations has been in operation throughout the islands.

Charcot Indorses Peary.—Dr. Jean Charcot, the French Arctic explorer, has come out strongly for Peary. In a rather passionately written monograph he asks why the French have failed to accord Peary honors which have been showered upon the American explorer by almost every other country. "Is it," he asks, "that because in France geography is generally ignored, and that, for the sake of hiding our ignorance, there is an endeavor to produce the impression of a greater knowledge than that possessed by others? Or is it from jealousy, because we are the nation which has made the least effort toward the conquest of polar mysteries? We owe it to our country, always so keenly hungry for justice, to settle this matter aright. All France, enthusiastic as it is over acts of heroism without distinction of nationality, owes it to itself to repair one of the greatest pieces of injustice of the century!

Standardizing Bread.—Sir Alfred Fripp, Surgeon in Ordinary to the King of England, and some other equally eminent British medical authorities, have issued a jointly signed statement in which they express the opinion that there is a national necessity for the fixing of the nutritive value of what is sold as bread. They argue that milk must conform with a certain standard, and there seems to be no reason why bread, which is equally important as a food, should not be made the subject of governmental control. Indeed, the standardization of bread is somewhat more important, since it constitutes about two-fifths of the weight of the food of the working classes. To quote the statement: "In view of the inferior nourishing qualities of the white bread commonly sold we urge legislation making it compulsory that all bread sold as such should be made of unadulterated wheat flour, containing at least eight per cent of whole wheat, including the germ and semolina."